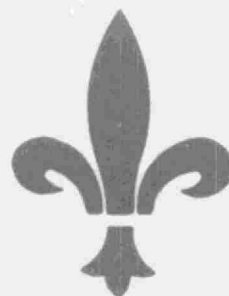


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ottawa river basin



water quality and its control in the ottawa river volume two — 1972

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OTTAWA RIVER BASIN

WATER QUALITY AND ITS CONTROL

IN THE

OTTAWA RIVER

PREPARED FOR THE PROVINCES OF

ONTARIO AND QUEBEC

BY

ONTARIO
WATER RESOURCES
COMMISSION

QUEBEC
WATER
BOARD

VOLUME TWO - 1972

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INTRODUCTION

This is the second volume of a two volume report entitled "Water Quality and Its Control in the Ottawa River". The report presents the findings of the joint study undertaken recently by the Ontario Water Resources Commission and the Quebec Water Board of the pollution of the Ottawa River. Volume I of the report contains a description of the basin and its resources, outlines water quality problems in the river, presents a water quality control plan for the river including proposed water quality standards and effluent requirements, and recommends additional studies that should be undertaken in the future. This volume contains the background information and data that support the findings of the study as presented in Volume I.

Bacteriological, biological, chemical and physical data are presented for the interprovincial section of the river. An assessment of the waste assimilation capacity is presented for the upper river downstream from the Timiskaming Dam to the Des Joachims Dam and for the lower river downstream from the Hull-Ottawa area to the Lake of Two Mountains. In addition, data are included for the industrial surveys that were conducted at the pulp and paper mills along the river, at the Electric Reduction Plant at Buckingham and at the Canada Packers plant at Hull; these data were incorporated into the models developed for assessing the waste assimilation capacity of the river. Detailed population projections are also presented for the entire Ottawa River Basin.

As in Volume I, the river has been sub-divided into six different zones. The section of the basin downstream from the Carillon Dam and the headwaters of the river lie completely within the Province of Quebec. These two areas have been designed as Zones 1 and 6, respectively. Zones 2, 3, 4 and 5 make up the 383 mile length of the interprovincial section of the river. Zone 2, downstream from Ottawa and Hull, is the most intensively developed section of the river and presently exposed to the greatest pollution pressures. Zone 3 is the section of the river upstream from the City of Ottawa supporting a high degree of recreational development; Zone 4 is the section of river from Des Joachims to Temiskaming where a good recreational potential is presently limited due to the discharge of excessive quantities of organic and solid wastes; Zone 5 is the section of the river known as Lake Timiskaming, which supports an excellent fishery as well as having a good potential for recreational development.

For reference purposes, the major maps presented in Volume I are included here. Figure I illustrates the main geographical features of the Ottawa River. Further details are illustrated in the map comprising Figure 2 which show the individual zones described below:

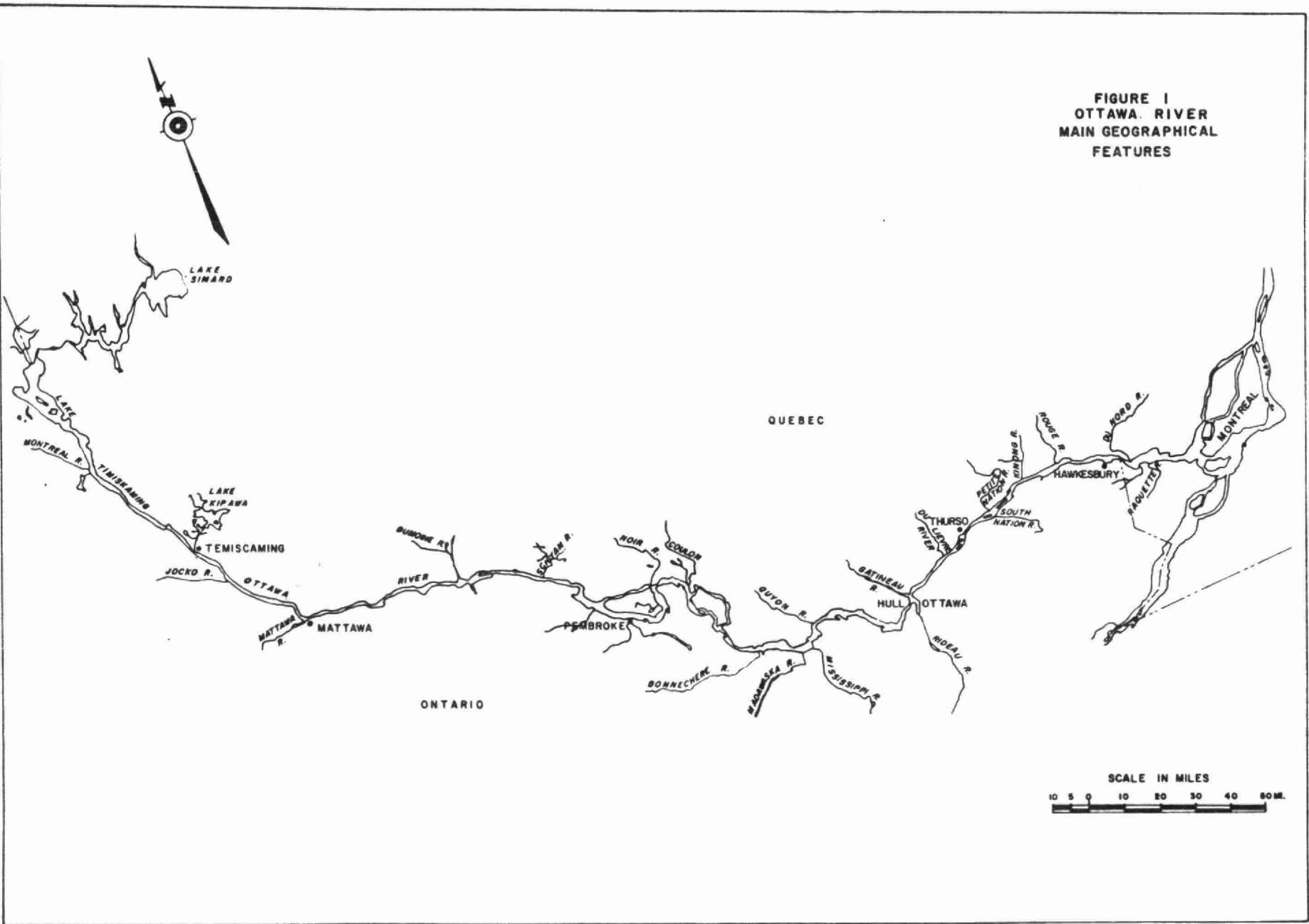
- a) Zone 1 is that part of the Ottawa River extending from the confluence of the Des Prairies River with the St. Lawrence River (R.M. 0.0) to the Hydro Quebec Carillon generating station (R.M.56.8) (Figure 2a).
- b) Zone 2 is that part of the Ottawa River extending from the Hydro Quebec Carillon generating station (R.M. 56.8) to the Chaudiere Dam at the Cities of Ottawa-Hull (R.M. 129.9) (Figure 2b).
- c) Zone 3 is that part of the Ottawa River extending from the Chaudiere Dam at the Cities of Ottawa-Hull (R.M. 129.9) to the Ontario Hydro Des Joachims generating station (R.M. 282.0) (Figure 2c).
- d) Zone 4 is that part of the Ottawa River extending from the Ontario Hydro Des Joachims generating station (R.M. 282.0) to the Canada Public Works Dam at the Town of Temiscaming (R.M. 372.4). (Figure 2d).
- e) Zone 5 is that part of the Ottawa River known as Lake Timiskaming (R.M. 372.4 to R.M. 440.2) extending upstream from the Canada Public Works Dam at the Town of Temiscaming (Figure 2e).
- f) Zone 6 is that part of the Ottawa River extending upstream from Lake Timiskaming (R.M. 440.2) and lying within the Province of Quebec (Figure 2e).

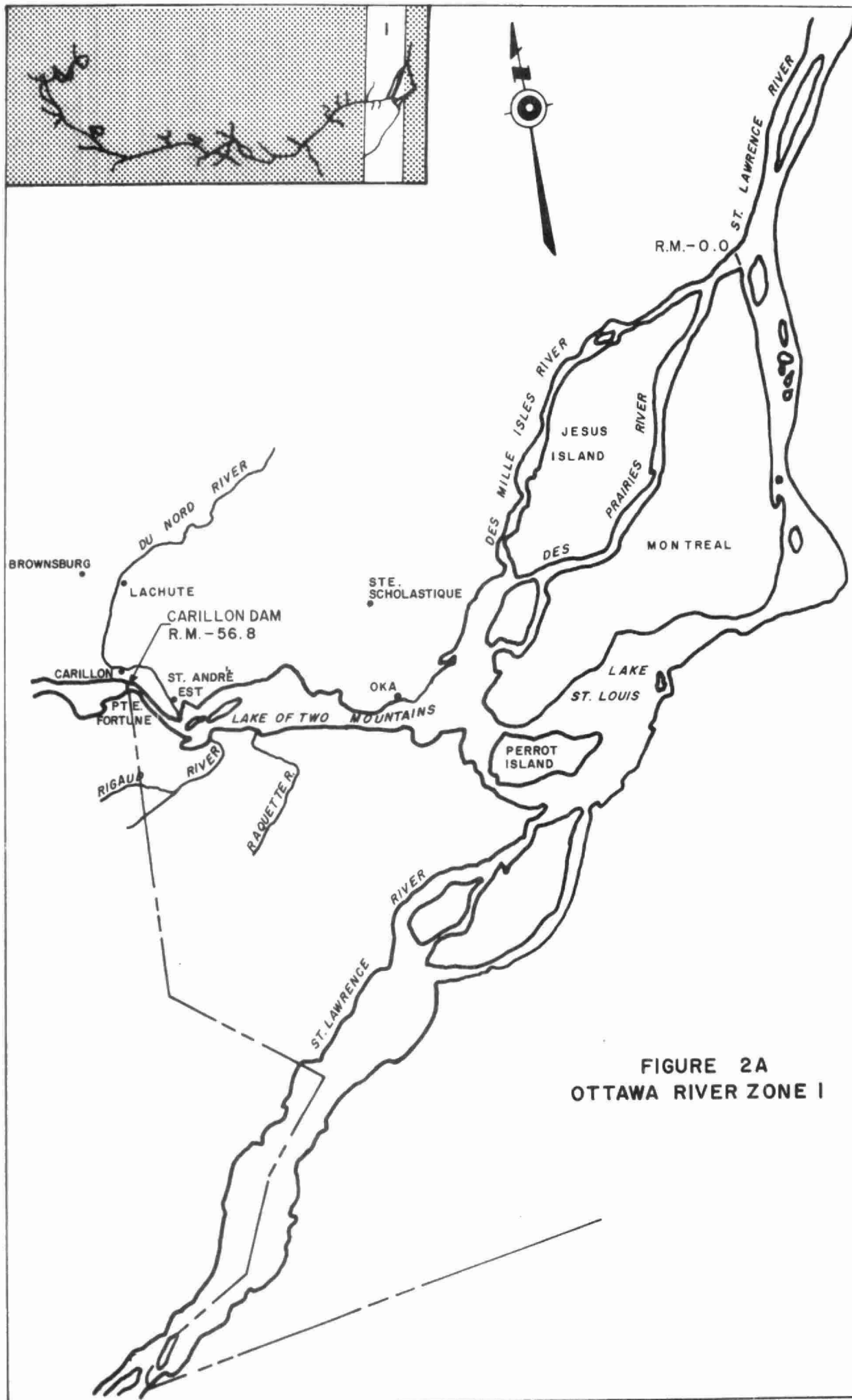
This volume summarizes the various chemical, physical and biological data that were collected during the course of the study, and used in arriving at the findings presented in Volume I.

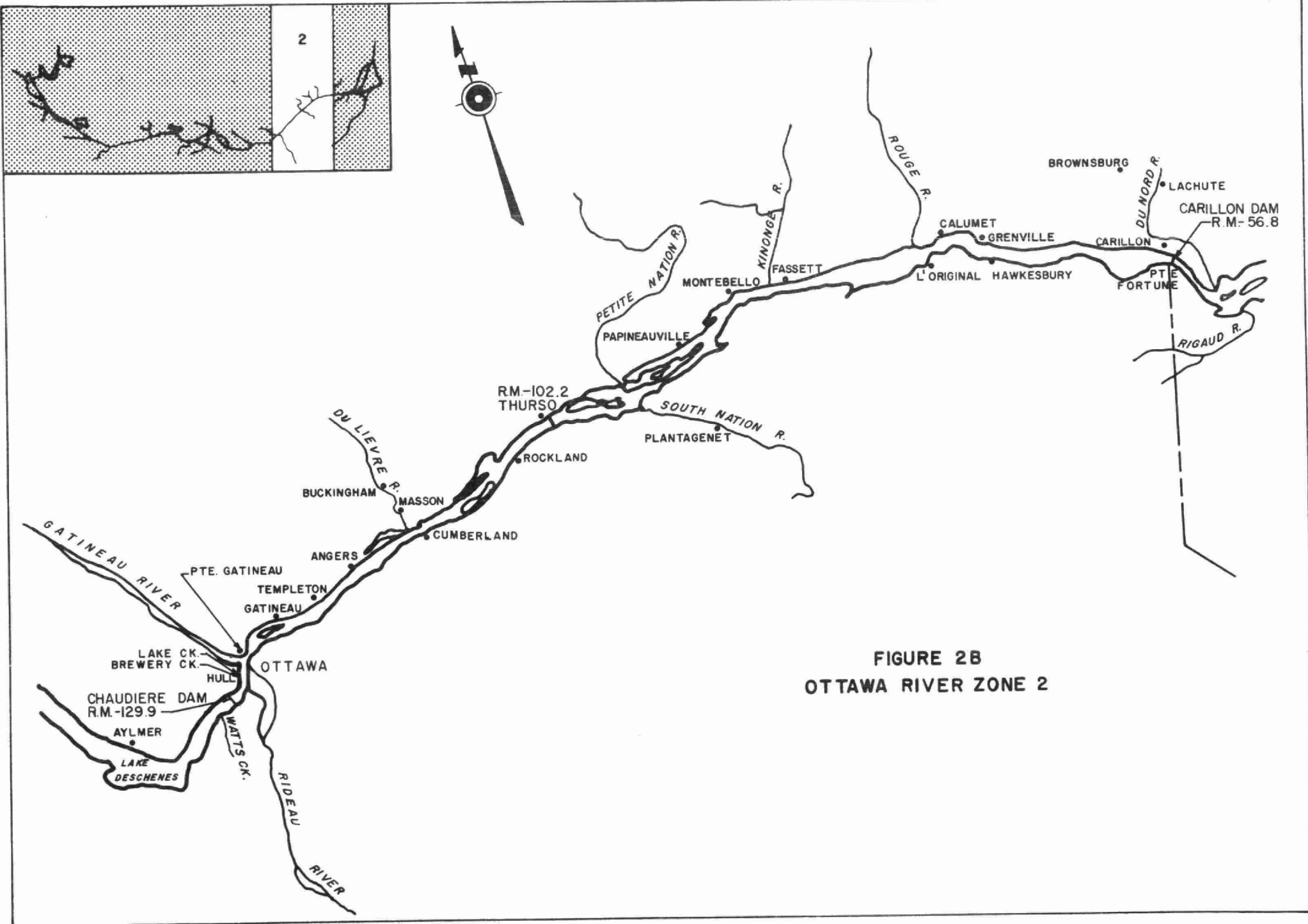
**FIGURE 1
OTTAWA RIVER
MAIN GEOGRAPHICAL
FEATURES**

This map illustrates the Ottawa River system, showing its course from Lake Simard in the north to the St. Lawrence River in the south. The river flows through the provinces of Quebec and Ontario. Key features include:

- Lakes:** Lake Simard, Lake Kipawa, and Lake Temiscaming.
- Tributaries:** Montreal R., Timiskaming R., Jocko R., Mattawa R., Bonne R., Severn R., Rich R., Edmon R., Bonaventure R., Maskinonge R., Mississipi R., Rideau R., South Nation R., and others.
- Cities and Towns:** Temiscaming, Mattawa, Pembroke, Hull, Ottawa, and Montreal.
- Geographical Labels:** QUEBEC and ONTARIO.
- Scale:** A scale bar at the bottom right indicates distances in miles (0 to 50).
- Compass:** A compass rose is located in the upper left corner.

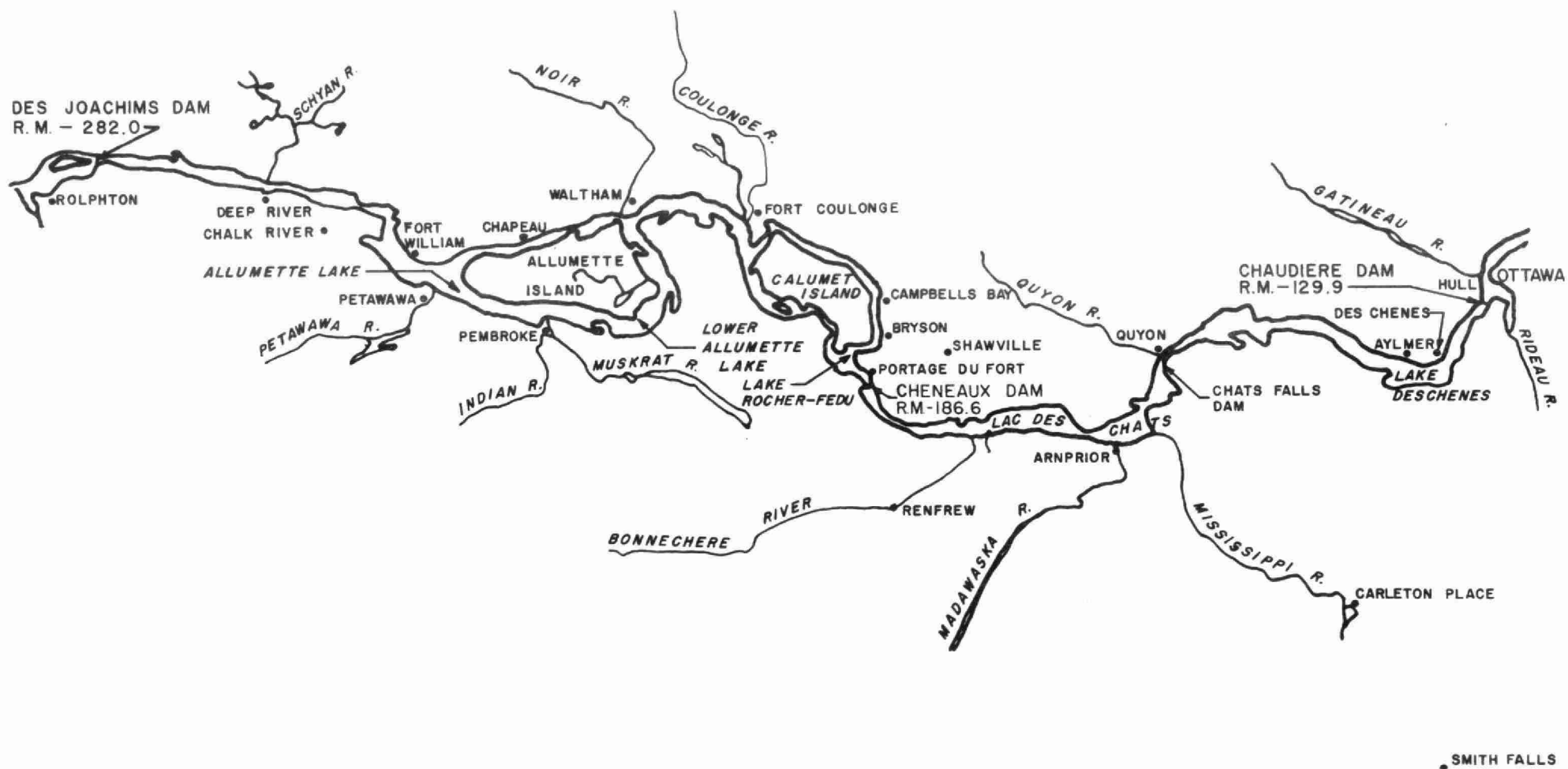


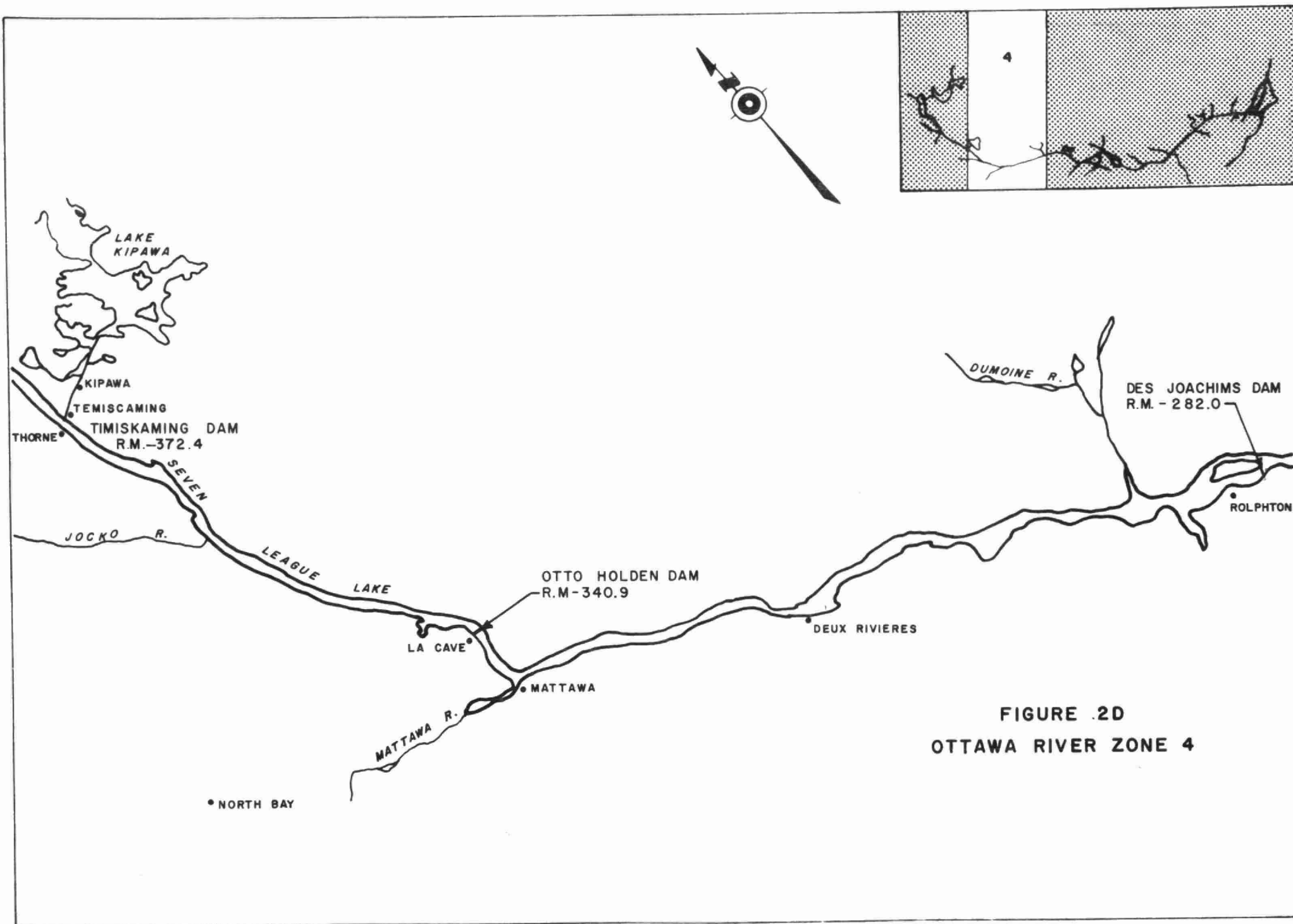




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FIGURE 2C
OTTAWA RIVER ZONE 3





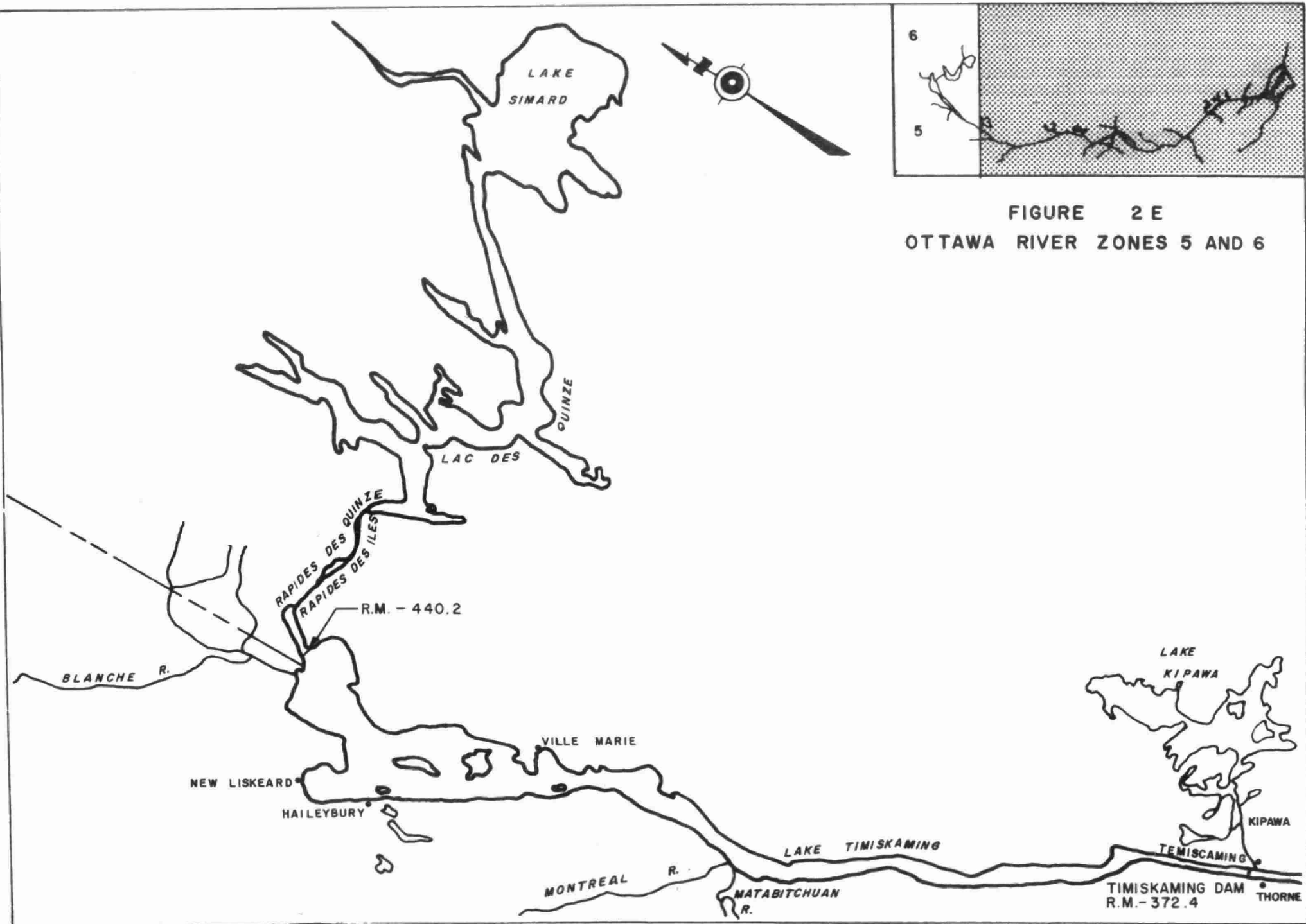


FIGURE 2 E
OTTAWA RIVER ZONES 5 AND 6

CHAPTER 1

BIOLOGY

1.1 SCOPE OF STUDY

Biological surveys were carried out in conjunction with water quality evaluations of the Ottawa River during 1968 and 1969. Data from these surveys complemented data collected during the same period on the physical, chemical and bacteriological aspects of water quality and, in addition, provided a direct measure of pollutional effects on aquatic biota.

Within the scope of the study, it was not possible to include an assessment of a wide range of biological parameters. Parameters selected were those considered useful as indicators of water quality while at the same time having significance with respect to water usage. On the basis of these criteria emphasis was placed on an examination of bottom fauna communities (Macroinvertebrates) and seston (suspended particulate matter).

Bottom fauna communities are typically comprised of a wide diversity of species occupying several trophic levels and having a wide range of environmental requirements and varying degrees of tolerance to toxic factors and environmental change. Accordingly, alterations in the composition and abundance of bottom fauna reflect changes in water quality and sediment composition at a given site over a considerable period of time prior to sampling. In addition, bottom fauna communities play an essential role in the conversion of energy and form an important segment of the food resource for a variety of fish species.

Principal components of the seston in the Ottawa River include wood fibre resulting from pulp and paper mill waste discharges and log driving, filamentous slime bacteria, the natural plankton of the river, and inorganic and organic detritus. Elevated concentrations of one or more of these often adversely affect a variety of water uses. Analysis of the seston was therefore carried out to provide a direct measure of the concentrations of waste components and to further evaluate pollutional effects on water usage and aquatic biota.

Collection of river sediments were undertaken in the course of the bottom fauna surveys. Results of physical and

chemical analyses are presented in this chapter because of their particular pertinence to the interpretation of the bottom fauna data.

Sampling and analytical methods along with results for the aforementioned studies are presented in the following sections.

1.2 BOTTOM FAUNA

1.2.1 Sampling Methods

Bottom fauna surveys were conducted between May and September in 1968 and 1969 throughout approximately 350 miles of river extending from lower Lake Timiskaming downstream to the vicinity of Oka (Lake of Two Mountains). Samples were collected at 195 stations on 112 ranges. Usually two and sometimes three stations, situated near each shore and mid-river, were sampled at each range. Ranges were established upstream from points of waste discharge (control) and at varying distances downstream depending on the strength, volume and nature of the waste source. In the selection of stations, efforts were made to minimize between station variability in depth and sediment composition, except for selected deep points within each section of the river.

Quantitative samples were collected at most stations using a Ponar dredge which sampled an area of 519 sq. cm. Usually five replicate samples were taken at each station in Zones 1 and 2 where substrate composition varied considerably between samples. Sometimes five, but usually fewer replicate samples were taken in Zones 3, 4 and 5 on the basis of a greater uniformity in sediment composition. In certain areas, particularly downstream from pulp and paper mill waste discharges where waste solids deposition was extensive and where diversity and density of fauna was reduced, sampling was not replicated, but a greater number of sites were sampled. In most cases, stations were sampled once during the survey period. Where it was desirable to provide continuity in the data over an extensive section of the river, sampling was repeated at selected stations to estimate seasonal variability.

Dredge contents were washed through a pail screen (24 meshes per inch; 0.0125 inch aperture) and the screened residue transferred to wide mouthed collecting jars for temporary storage prior to sorting for removal of bottom fauna organisms.

Sorting was accomplished by spreading the residue evenly over large, white enamel trays and removing the organisms by hand picking. Where large quantities of coarse material were encountered, total numbers were estimated after sorting a portion of the material. Organisms were initially preserved in 95 percent ethyl alcohol and were later transferred to 70 percent alcohol for permanent storage.

Where quantitative dredging was not possible due to firm substrates or strong currents or where sediment composition was particularly variable between stations in a given section of river, samples were collected by means of "artificial substrate" samplers. These consisted of 8 x 8 x 7 inch high, coarse wire baskets filled with two inch crushed limestone. Samplers were suspended in the river just above the bottom or resting on a firm bottom and retrieved following a period of from four to six weeks. Organisms were removed by washing and brushing each stone. Samples were then screened and treated in the same way as previously described for dredge samples.

While this method of sampling seldom estimated naturally occurring communities, it provided a means of obtaining samples under otherwise difficult sampling conditions and facilitated evaluations of water quality effects on species composition and relative abundance of organisms between stations where sediment composition was variable. In addition, a comparison of communities colonizing artificial substrates with those occurring naturally at the same site provided a measure of the effect of physical and chemical alterations of sediments.

1.1.2 Sample Analysis

Specimens were enumerated and identified to genus in most cases and in some cases to species. Midge larvae (Chironomidae) were not identified. All specimens occurring in the collections were examined except for the Tubificidae for which approximately twenty-five specimens from each sample were identified. Where this represented only a portion of the sample, species composition for the total sample was estimated by direct proportions.

1.1.3 Results

Bottom fauna collections are summarized in Table 1.1 (quantitative data) and in Table 1.2 (artificial substrate data). For supplementary information relating to sampling dates, depths and sediment characteristics, reference should be made to Table 1.4 and Table 1.5, respectively.

Samples have been placed in the permanent collections of the Biology Branch, OWRC, as items 68B.786 to 68B.1447 and 69B3.1 to 69B3.316.

1.3 SESTON

1.3.1 Methods

Samples were collected on one occasion in 1969 at 65 stations on 48 ranges located above and below points of major waste discharges.

At each station, one sample of from 40 to 60 gallons of surface water was poured through a #20 plankton net (80 micron aperture) fitted with a collecting bucket. Contents of the net were washed into 4 oz. collecting jars and preserved with 5 percent formaldehyde. Samples were further concentrated using the Sedgewick-Rafter sand filtration technique (A.P.H.A., 1965). One millilitre of the final concentrate was transferred to a Sedgewick-Rafter counting cell and one strip was examined at 200 x magnification. Areal standard units (one a.s.u. = 400 square microns) were recorded for each major component categorized as algae, zooplankton, wood fibre, sewage fungus (*Sphaerotilus natans*), and detrital material, and for genera of algae and zooplankton.

1.3.2 Results

Results, reported as a.s.u./ml of river water, are summarized in Table 1.3. While values are probably quantitative for wood fibre and sewage fungus, estimates of plankton and detritus are low as a result of losses, of much of the nanoplankton and smaller detritus, incurred in the initial concentrating technique.

1.4 SEDIMENTS

Information on sediment composition particularly with respect to the extent and degree of waste solids deposition was obtained in the course of bottom fauna sampling and additional supplementary dredging carried out to provide greater detail below points of major waste discharges.

Dredge contents were examined visually both before and after screening and the approximate proportions of the major components were recorded. These data are included in Table 1.4.

Samples of approximately the upper two inches of sediment were collected at each site. Results of analysis of mercury content in sediments at selected sites are presented in Table 1.6.

TABLE 1.1

QUANTITATIVE BOTTOM FAUNA COLLECTIONS
OTTAWA RIVER, 1968 AND 1969
NUMBERS OF ORGANISMS PER PONAR DREDGE SAMPLE

Note:

1. For information on depth, sediment description and sampling dates, reference should be made to Table 1.4.
2. Complete list of taxa has not been presented; for further information, reference should be made to Ottawa River data file, Biology Branch, OWRC.
3. Stations are designated by river miles upstream from the confluence of Des Prairies River with the St. Lawrence River (RM 0.0) as illustrated in the zone maps in the Introduction; A - stations near the south shore; B - stations near the north shore; and C - stations near mid-river.
4. Qual. - indicates samples considered to be qualitative; collection composited from one or more ponar dredge grabs.

TABLE 1.1

QUANTITATIVE BOTTOM FAUNA COLLECTIONS, OTTAWA RIVER, 1968 AND 1969
NUMBERS OF ORGANISMS PER PONAR DREDGE SAMPLE

STATIONS TAXA	385.5				381.7				372.0			
	A Avg.	Range	C Avg.	Range	C Avg.	Range	B Avg.	Range	A Avg.	Range	B Avg.	Range
Ephemeroptera												
Ephemeridae	0.4	0-1			0.2	0-1						
Others												
Trichoptera												
Psychomyiidae												
Leptoceridae	0.2	0-1										
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	0.2	0-1	0.2	0-1	1.6	1-4	3.2	1-5	6.5	5-8		
Others	0.6	0-2					0.8	0-2				
Amphipoda												
Isopoda												
Gastropoda												
Pulmonata												
Branchiata												
Pelecypoda												
Sphaeriidae	0.2	0-1	0.6	0-3			0.4	0-2				
Unionidae												
Hirudinea												
Oligochaeta												
Tubificidae			0.8	0-3	0.6	0-1	0.6	0-1	9.0	2-16	32	
Lumbriculidae												
Naididae												
Others							0.4	0-1				
TOTAL AVG.NO.ORGANISMS	1.6		1.6		2.4		5.6		15.5		32	
TOTAL NO. OF TAXA	5		4		4		7		5		1	
AVG. NO. OF TAXA	1.4		1.2		1.6		3		3		1	
NO. OF SAMPLES	5		5		5		5		2		1	

TABLE 1.1 (continued)

STATIONS TAXA	371.7				371.4				370.7			
	A Avg.	B Range	A Avg.	B Range	A Avg.	B Range	A Avg.	B Range	A Avg.	C Range	A Avg.	C Range
Ephemeroptera												
Ephemeridae												
Others												
Trichoptera												
Psychomyiidae												
Leptoceridae												
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	27.5	17-38			84		4		2			
Others												
Amphipoda	0.5	0-1							2			
Isopoda	1.5	1-2			5							
Gastropoda												
Pulmonata	15.5	8-23										
Branchiata												
Pelecypoda												
Sphaeriidae	1.5	0-3										
Unionidae												
Hirudinea									4			
Oligochaeta												
Tubificidae	4.0	0-8					13					
Lumbriculidae	3.0	1-5			1				12			
Naididae	14.0	2-26										
Others	7.5	6-9										
TOTAL AVG.NO.ORGANISMS	75.0		0		90		17		20		0	
TOTAL NO. OF TAXA	18		0		3		3		5		0	
AVG. NO. OF TAXA	12		0		3		3		5		0	
NO. OF SAMPLES	2		2		1		1		1		1	

TABLE 1.1 (continued)

STATIONS TAXA	370.7 B Avg. Range		370.1 A C B Avg. Range Avg. Range Avg. Range				368.8 A C Avg. Range Avg. Range			
Ephemeroptera										
Ephemeridae										
Others										
Trichoptera										
Psychomyiidae										
Leptoceridae										
Others										
Neuroptera										
Odonata										
Diptera										
Chironomidae			8							
Others										
Amphipoda										
Isopoda										
Gastropoda										
Pulmonata										
Branchiata										
Pelecypoda										
Sphaeriidae										
Unionidae										
Hirudinea										
Oligochaeta										
Tubificidae										
Lumbriculidae			7		2					
Naididae										
Others										
TOTAL AVG.NO.ORGANISMS	0		15		2		0	0		0
TOTAL NO. OF TAXA	0		3		1		0	0		0
AVG. NO. OF TAXA	0		3		1		0	0		0
NO. OF SAMPLES	1		1		1		1	1		2

TABLE 1.1 (continued)

STATIONS TAXA	368.8		367.4						366.2			
	B		A		C		B		A		C ₁	
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae												
Others												
Trichoptera												
Psychomyiidae												
Leptoceridae												
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae							7					
Others												
Amphipoda												
Isopoda												
Gastropoda												
Pulmonata												
Branchiata												
Pelecypoda												
Sphaeriidae												
Unionidae												
Hirudinea												
Oligochaeta												
Tubificidae											16	
Lumbriculidae												
Naididae												
Others							3					
TOTAL AVG.NO.ORGANISMS	0		0		0		10		0		16	
TOTAL NO. OF TAXA	0		0		0		2		0		1	
AVG. NO. OF TAXA	0		0		0		2		0		1	
NO. OF SAMPLES	1		1		1		1		1		1	

TABLE 1.1 (continued)

STATIONS TAXA	366.2						364.2					
	C ₂		C ₃		B		A		C		B	
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae												
Others												
Trichoptera												
Psychomyiidae												
Leptoceridae												
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae							3.0	0-6			1	
Others												
Amphipoda												
Isopoda							0.5	0-1				
Gastropoda												
Pulmonata												
Branchiata												
Pelecypoda												
Sphaeriidae											1	
Unionidae												
Hirudinea											1	
Oligochaeta												
Tubificidae	9						132.5	11-254			23	
Lumbriculidae							1.5	0-3				
Naididae											1	
Others												
TOTAL AVG.NO.ORGANISMS	9		0		0		138.5		0		27	
TOTAL NO. OF TAXA	1		0		0		6		0		6	
AVG. NO. OF TAXA	1		0		0		4		0		6	
NO. OF SAMPLES	1		1		1		2		1		1	

TABLE 1.1 (continued)

STATIONS TAXA	362.2						356.1					
	A	C	B	A	C	B	A	C	B	A	C	B
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae												
Others												
Trichoptera												
Psychomyiidae												
Leptoceridae												
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	16						6		18			70
Others												
Amphipoda							10					2
Isopoda							10					46
Gastropoda												
Pulmonata												
Branchiata												
Pelecypoda												
Sphaeriidae	7											
Unionidae												
Hirudinea	1											
Oligochaeta												
Tubificidae					1		2		312			6
Lumbriculidae	1											
Naididae												
Others												1
TOTAL AVG.NO.ORGANISMS	25		0		1		28		330			125
TOTAL NO. OF TAXA	5		0		1		4		3			7
AVG. NO. OF TAXA	5		0		1		4		3			7
NO. OF SAMPLES	1		1		1		1		1			1

TABLE 1.1 (continued)

STATIONS TAXA	352.9						349.5		350.5			
	A	C	B	A	C	B	A	C	B	A	C	B
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae												
Others												
Trichoptera												
Psychomyiidae							1					
Leptoceridae												
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	22		11		11		40		4		30	
Others							2					
Amphipoda												
Isopoda	3				9		5					
Gastropoda												
Pulmonata												
Branchiata												
Pelecypoda												
Sphaeriidae					6							
Unionidae												
Hirudinea	1				2						1	
Oligochaeta												
Tubificidae	18		2820				4		1344			
Lumbriculidae												
Naididae												
Others							1					
TOTAL AVG.NO.ORGANISMS	44		2831		28		53		1348		31	
TOTAL NO. OF TAXA	5		2		5		7		3		2	
AVG. NO. OF TAXA	5		2		5		7		3		2	
NO. OF SAMPLES	1		1		1		1		1		1	

TABLE 1.1 (continued)

STATIONS TAXA	347.3 B		345.1				342.6 B		340.9			
	Avg.	Range	A Avg.	Range	B Avg.	Range	Avg.	Range	A Avg.	Range	C Avg.	Range
Ephemeroptera												
Ephemeridae												
Others												
Trichoptera												
Psychomyiidae												
Leptoceridae							0.2	0-2	11.8	5-21		
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	30		6		59		52.3	46-58			2.0	1-3
Others												
Amphipoda							0.3	0-1	6.4	1-22		
Isopoda	34				12		5.7	3-10	124.0	92-151		
Gastropoda												
Pulmonata	2								0.2	0-1		
Branchiata												
Pelecypoda												
Sphaeriidae	8				1		14.3	4-23	11.8	1-22	0.2	0-1
Unionidae												
Hirudinea							0.3	0-1	1.2	0-2		
Oligochaeta												
Tubificidae					7		47.0	14-108	0.6	0-1	842	208-
Lumbriculidae							0.3	0-1	0.8	0-3		1224
Naididae												
Others	1											
TOTAL AVG.NO.ORGANISMS	75		6		79		120.4		156.8		844.2	
TOTAL NO. OF TAXA	6		1		4		11		13		6	
AVG. NO. OF TAXA	6		1		4		4		6		3	
NO. OF SAMPLES	1		1		1		3		5		5	

TABLE 1.1 (continued)

STATIONS TAXA	339.5		338.9				337.5					
	Avg. ^C	Range	Avg. ^A	Range	Avg. ^B	Range	Avg. ^A	Range	Avg. ^C	Range	Avg. ^B	Range
Ephemeroptera												
Ephemeridae	0.2	0-1	2.4	1-5	6.8	3-13	5				5	
Others												
Trichoptera												
Psychomyiidae												
Leptoceridae	0.2	0-1	2.6	0-5	2.4	1-5	7				3	
Others												
Neuroptera											1	
Odonata												
Diptera												
Chironomidae	6.2	1-11	11.8	2-26	4.0	1-4	2		7		7	
Others			1.6	1-4	0.6	0-2			2			
Amphipoda			0.2	0-1								
Isopoda	9.6	2-28	10.4	4-17	2.6	2-7			14		4	
Gastropoda												
Pulmonata												
Branchiata			0.2	0-1							1	
Pelecypoda												
Sphaeriidae	1.4	0-4	0.6	0-1	4.6	0-13			24		5	
Unionidae			0.2	0-1								
Hirudinea	0.2	0-1	0.2	0-1	0.2	0-1			1			
Oligochaeta												
Tubificidae	2.2	0-4	2.4	0-10	0.4	0-2			28			
Lumbriculidae	7.2	2-19	7.2	1-15	5.6	4-15			63			
Naididae												
Others	0.2	0-1			0.2	0-1						
TOTAL AVG.NO.ORGANISMS	27.4		39.8		27.4		14		139		26	
TOTAL NO. OF TAXA	15		14		14		3		10		10	
AVG. NO. OF TAXA	6.6		8.4		7.8		3		10		10	
NO. OF SAMPLES	5		5		5		1		1		1	

TABLE 1.1 (continued)

STATIONS TAXA	333.4				329.3				328.5		322.4	
	A Avg.	B Range	A Avg.	B Range	A Avg.	B Range	A Avg.	B Range	C Avg.	Range	A Avg.	Range
Ephemeroptera												
Ephemeridae			0.5	0-1	3.0	0-6	11.0	9-13			2.0	2-2
Others												
Trichoptera												
Psychomyiidae											0.5	0-1
Leptoceridae							0.5	0-1				
Others												
Neuroptera			0.5	0-1								
Odonata												
Diptera												
Chironomidae	8.0	4-12	9.5	6-13	9.0	7-11	2.5	1-4			6.0	6-6
Others					2.0	1-3	0.5	0-1				
Amphipoda							2.5	1-4				
Isopoda	1.0	0-2	2.5	1-4	2.5	2-3	14.5	5-24	8			
Gastropoda												
Pulmonata												
Branchiata							0.5	0-1	1			
Pelecypoda												
Sphaeriidae	2.5	2-3	1.0	0-2	1.5	1-2	6.0	1-11	10			
Unionidae												
Hirudinea					1.0	1-1	1.5	0-3				
Oligochaeta												
Tubificidae	1.0	0-2	2.5	0-5	0.5	0-1	0.5	0-1			1.0	0-2
Lumbriculidae	0.5	0-1			1.0	0-2	1.5	0-3	1			
Naididae												
Others					1.0	0-2	0.5	0-1			1.0	0-2
TOTAL AVG.NO.ORGANISMS	13.0		16.5		21.5		42.0		20		10.5	
TOTAL NO. OF TAXA	7		9		11		14		6		6	
AVG. NO. OF TAXA	4		5.5		8		9.5		6		4.5	
NO. OF SAMPLES	2		2		2		2		1		2	

TABLE 1.1 (continued)

STATIONS TAXA	322.4		314.2		300.7				288.7			
	B Avg. Range		A Avg. Range		A Avg. Range		B Avg. Range		A Avg. Range		B Avg. Range	
Ephemeroptera												
Ephemeridae	0.5	0-1							1.8	0-4		
Others												
Trichoptera												
Psychomyiidae	0.5	0-1	0.7	0-2								
Leptoceridae	0.5	0-1										
Others												
Neuroptera	2.5	0-5							0.5	0-1		
Odonata												
Diptera												
Chironomidae	1.0	0-2	9.1	2-20	23.5	15-32	4		6.8	2-14	24	
Others			13.3	4-24								
Amphipoda			0.3	0-1							1	
Isopoda	2.5	1-4	4.7	0-14								
Gastropoda												
Pulmonata												
Branchiata												
Pelecypoda												
Sphaeriidae	6.0	1-11	1.3	0-4								
Unionidae												
Hirudinea	3.5	0-7										
Oligochaeta												
Tubificidae	3.0	2-4			1.0	0-2			1.8	0-5	11	
Lumbriculidae												
Naididae												
Others			2.7	0-8								
TOTAL AVG.NO.ORGANISMS	20.0		32.1		24.5		4		10.9		36	
TOTAL NO. OF TAXA	12		7		3		1		8		6	
AVG. NO. OF TAXA	7		3.7		2.5		1		4.3		6	
NO. OF SAMPLES	2		3		2		1		4		1	

TABLE 1.1 (continued)

STATIONS TAXA	270.4		255.8						246.0		242.2	
	C		A		C		B		C		A	
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae			3.6	0-5			7.4	5-15	4.5	2-8		
Others												
Trichoptera												
Psychomyiidae			0.4	0-1			0.2	0-1				
Leptoceridae			0.2	0-1								
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	1.4	0-3	7.4	3-15	1.4	0-3	3.0	1-6	17.0	9-31	3	
Others			0.4	0-1			0.2	0-1	1.5	0-3		
Amphipoda			0.2	0-1					0.2	0-1		
Isopoda												
Gastropoda												
Pulmonata												
Branchiata	0.2	0-1	0.6	0-2								
Pelecypoda												
Sphaeriidae	1.4	0-4			2.8	1-5	0.4	0-1	1.8	0-8		
Unionidae									0.5	0-1		
Hirudinea												
Oligochaeta												
Tubificidae	4.8	3-8	0.4	0-1	9.0	5-15						
Lumbriculidae									1.8	1-2		
Naididae												
Others			0.4	0-1					0.2	0-1		
TOTAL AVG.NO.ORGANISMS	7.8		13.6		13.2		11.2		27.5		3	
TOTAL NO. OF TAXA	9		11		6		6		11		1	
AVG. NO. OF TAXA	4.2		5.8		3.4		3		5.8		1	
NO. OF SAMPLES	5		5		5		5		4		1	

TABLE 1.1 (continued)

STATIONS TAXA	242.0		240.5		240.5		238.9		240.2			
	A		A		A		A		A		C	
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae	1						1		0.6	0-3		
Others												
Trichoptera												
Psychomyiidae							2		0.8	0-3		
Leptoceridae									0.2	0-1		
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	15				20	9-31	8		12.6	6-22	4.2	1-6
Others									0.4	0-2	0.2	0-1
Amphipoda	3						1					
Isopoda												
Gastropoda												
Pulmonata												
Branchiata									0.2	0-1	0.6	0-2
Pelecypoda												
Sphaeriidae	1								1.4	0-5	3.0	0-7
Unionidae	4								0.2	0-1		
Hirudinea	2											
Oligochaeta												
Tubificidae											2.2	1-5
Lumbriculidae												
Naididae	1											
Others											0.2	0-1
TOTAL AVG.NO.ORGANISMS	27		0		20		12		16.4		10.4	
TOTAL NO. OF TAXA	10		0		2		5		9		10	
AVG. NO. OF TAXA	27		0		2		5		3.8		4.8	
NO. OF SAMPLES	1		1		2		1		5		5	

TABLE 1.1 (continued)

STATIONS TAXA	240.2		195.8						192.3			
	B Avg. Range		A Avg. Range		C Avg. Range		B Avg. Range		A Avg. Range		B Avg. Range	
Ephemeroptera												
Ephemeridae	1.8	0-4	15.2	7-22			3.6	3-7	1.5	1-2	0.8	0-1
Others												
Trichoptera												
Psychomyiidae	0.4	0-1	2.2	0-4			0.2	0-1	2.0	0-6	0.2	0-1
Leptoceridae											0.8	0-1
Others												
Neuroptera			1.0	0-2			1.2	0-3	0.5	0-1		
Odonata												
Diptera												
Chironomidae	1.4	0-3	13.4	11-15			4.8	2-11			0.5	0-2
Others	0.4	0-2	0.2	0-1			0.2	0-1				
Amphipoda					1						0.2	0-1
Isopoda												
Gastropoda												
Pulmonata												
Branchiata	0.6	0-2			1							
Pelecypoda												
Sphaeriidae			3.4	2-7	30		2.2	0-6	7.2	0-11	11.0	2-25
Unionidae			0.4	0-1					.5		0.8	0-3
Hirudinea												
Oligochaeta												
Tubificidae			0.8	0-1	4		0.2	0-1		0-8		
Lumbriculidae										0-2	0.5	
Naididae												
Others												
TOTAL AVG.NO.ORGANISMS	4.6		36.6		36		12.4		11.7		14.8	
TOTAL NO. OF TAXA	8		9		4		8		7		10	
AVG. NO. OF TAXA	3.2		5.4		4		4.2		4.2		4.5	
NO. OF SAMPLES	5		5		1		5		4		4	

TABLE 1.1 (continued)

STATIONS TAXA	191.9				191.6				190.4		189.1	
	Avg. C	Range B	Avg. B	Range	Avg. A	Range B	Avg. B	Range	Avg. B	Range	Avg. A	Range
Ephemeroptera												
Ephemeridae	3.0	0-7	4.2	2-8	5.5	4-9	0.6	0-2	0.2	0-1	10.2	5-17
Others									0.2	0-1		
Trichoptera												
Psychomyiidae	0.2	0-1			0.2	0-1	1.4	1-2			0.8	0-4
Leptoceridae	0.5	0-1			0.2	0-1			0.2	0-1	0.4	0-1
Others												
Neuroptera							0.2	0-1			0.2	0-1
Odonata												
Diptera												
Chironomidae	92.0	0-224	2.2	1-4	13.0	4-17	2.2	0-7	0.6	0-2	6.4	3-11
Others	0.5	0-2			0.2	0-1						
Amphipoda												
Isopoda												
Gastropoda												
Pulmonata												
Branchiata			0.2	0-1	0.2	0-1						
Pelecypoda												
Sphaeriidae	3.2	0-10	11.2	5-16	9.2	4-18	4.6	2-8	9.6	0-30	1.4	0-4
Unionidae	0.8	0-2	0.6	0-2	1.0	0-2	0.8	0-1	1.8	0-4	0.4	0-1
Hirudinea			0.2	0-1	0.7	0-1						
Oligochaeta												
Tubificidae												
Lumbriculidae	0.2	0-1							1.0	0-4		
Naididae												
Others	1.0	0-4	0.2	0-1								
TOTAL AVG.NO.ORGANISMS	101.4		18.8		30.2		9.8		13.6		19.8	
TOTAL NO. OF TAXA	14		8		11		9		10		10	
AVG. NO. OF TAXA	5.0		5.0		6.0		4.4		4.0		4.2	
NO. OF SAMPLES	4		5		4		5		5		5	

TABLE 1.1 (continued)

STATIONS TAXA	189.1		182.9		175.7				172.5		170.1	
	B Avg. Range		C Avg. Range		A Avg. Range		B Avg. Range		C Avg. Range		A Avg. Range	
Ephemeroptera												
Ephemeridae	1.6	1-2			19.4	6-30	3.6	1-6	5.6	0-11	15	
Others			0.2	0-1								
Trichoptera												
Psychomyiidae					1.6	0-4	0.4	0-1			2	
Leptoceridae	0.2	0-1	0.4	0-1								
Others												
Neuroptera	0.2	0-1			0.2	0-1	0.4	0-1	0.2	0-1		
Odonata												
Diptera												
Chironomidae	8.6	3-13	1.6	0-3	4.6	2-8	3.0	2-4	9.0	6-13	9	
Others			0.6	0-3			7.0	5-12	1.0	0-2		
Amphipoda			0.2	0-1								
Isopoda												
Gastropoda												
Pulmonata												
Branchiata			3.4	1-8	0.4	0-1	0.6	0-1	0.8	0-1	1	
Pelecypoda												
Sphaeriidae	0.2	0-1	28.2	6-51	2.4	0-5	1.0	0-2	6.2	1-10	7	
Unionidae			0.2	0-1			0.2	0-1	0.4	0-1		
Hirudinea			0.4	0-1								
Oligochaeta												
Tubificidae	1.2	0-11							1.0	0-2		
Lumbriculidae	0.4	0-1	0.6	0-1			0.4	0-1				
Naididae												
Others			0.2	0-1			0.2	0-1				
TOTAL AVG.NO.ORGANISMS	14.4		36.0		28.6		16.8		24.2		34	
TOTAL NO. OF TAXA	6		19		10		16		16		8	
AVG. NO. OF TAXA	3.6		6.8		5.4		7.2		8.4		8	
NO. OF SAMPLES	5		5		5		5		5		1	

TABLE 1.1 (continued)

STATIONS TAXA	169.7 A		169.6 A		168.7 A		168.2 A		168.0 A C			
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae	1				1							
Others												
Trichoptera												
Psychomyiidae	2				2							
Leptoceridae												
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	4		3		4				3.0	1-8	2.4	0-6
Others									0.4	0-1		
Amphipoda												
Isopoda												
Gastropoda												
Pulmonata												
Branchiata												
Pelecypoda												
Sphaeriidae	3						1				4.4	2-8
Unionidae	4						1		1.0	1-1	0.2	0-1
Hirudinea												
Oligochaeta												
Tubificidae					86							
Lumbriculidae									1.0	0-2		
Naididae												
Others									0.2	0-1		
TOTAL AVG.NO.ORGANISMS	12		3		93		2		5.6		7.0	
TOTAL NO. OF TAXA	5		2		5		2		9		5	
AVG. NO. OF TAXA	5		2		5		2		3.8		3	
NO. OF SAMPLES	1		1		1		1		5		5	

TABLE 1.1 (continued)

STATIONS TAXA	168.0 B		156.4 C		A		149.9 C		B		143.3 A	
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae			35.6	20-42	2.4	0-5	3.4	0-5	7.8	5-12	7.4	5-13
Others			0.2	0-1								
Trichoptera												
Psychomyiidae			3.0	0-8	0.4	0-1	0.2	0-1	1.2	0-3	0.6	0-1
Leptoceridae					0.2	0-1						
Others												
Neuroptera			0.2	0-1	0.4	0-1			0.2	0-1	0.2	0-1
Odonata												
Diptera												
Chironomidae			25.2	9-35	2.2	0-5	0.8	0-2	0.4	0-1	11.4	6-12
Others	1.6	1-3	1.4	0-3	0.8	0-2	0.2	0-1			0.8	0-3
Amphipoda			2.4	0-4			0.2	0-1	1.2	0-3	1.0	0-2
Isopoda												
Gastropoda												
Pulmonata												
Branchiata	8.8	7-12	6.4	4-9	0.6	0-3	0.6	0-1	0.2	0-1	0.2	0-1
Pelecypoda												
Sphaeriidae	0.2	0-1	6.2	2-8	4.4	0-13	15.0	4-24	2.8	0-7	3.8	0-7
Unionidae	0.4	0-1	0.4	0-1	1.4	0-3	0.6	0-1	3.8	1-6		
Hirudinea												
Oligochaeta												
Tubificidae	0.2	0-1	17.2	0-47	0.2	0-1	0.2	0-1			0.8	0-1
Lumbriculidae			2.8	0-5	0.2	0-1	4.0	1-8	0.6	0-2		
Naididae												
Others	0.2	0-1	1.0	1-1	0.4	0-1						
TOTAL AVG.NO.ORGANISMS	11.4		102.0		13.6		25.2		18.2		26.2	
TOTAL NO. OF TAXA	9		23		18		13		13		13	
AVG. NO. OF TAXA	4.6		15.4		6.4		6.4		6.4		8.6	
NO. OF SAMPLES	5		5		5		5		5		5	

TABLE 1.1 (continued)

STATIONS TAXA	143.3				136.5		128.7					
	C		B		C		A		C		B	
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae			4.8	4-6	21.2	10-31						
Others												
Trichoptera												
Psychomyiidae			1.0	0-2	4.4	0-10						
Leptoceridae	0.4	0-1					1					
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	14.0	7-21	2.8	2-4	6.6	3-13	10		39		25	
Others	0.8	0-2			0.4	0-1						
Amphipoda			0.2	0-1	0.4	0-2	1		3			
Isopoda									9			
Gastropoda												
Pulmonata	0.2	0-1					10					
Branchiata					1.2	0-3	8					
Pelecypoda												
Sphaeriidae	12.8	2-26	1.0	0-3	6.8	0-14			1			
Unionidae			0.2	0-1	0.4	0-1						
Hirudinea	0.4	0-1							2		1	
Oligochaeta												
Tubificidae	37.8	14-72			0.2	0-1						
Lumbriculidae			0.2	0-1					1			
Naididae												
Others			0.2	0-1			20		17			
TOTAL AVG.NO.ORGANISMS	66.4		10.4		41.6		50		72		27	
TOTAL NO. OF TAXA	11		11		13		8		8		3	
AVG. NO. OF TAXA	7.8		10		7.8		8		8		3	
NO. OF SAMPLES	5		5		5		Qual.		Qual.		Qual.	

TABLE 1.1 (continued)

STATIONS TAXA	128.3						127.8		127.4			
	A		C		B		A		A		B	
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae												
Others							1		0.6	0-2		
Trichoptera												
Psychomyiidae												
Leptoceridae							1		0.2	0-1	1	
Others												
Neuroptera												
Odonata							1					
Diptera												
Chironomidae	2		32		12		14		2.8	0-3	5	
Others												
Amphipoda							14		1.0	0-1	1	
Isopoda			14				1				99	
Gastropoda												
Pulmonata							4		1.4	0-4	19	
Branchiata							2		11.2	5-25	6	
Pelecypoda												
Sphaeriidae	19								0.2	0-1		
Unionidae												
Hirudinea												
Oligochaeta											49	
Tubificidae	2		2						0.2	0-1		
Lumbriculidae			8						0.2	0-1		
Naididae							6					
Others							22		2.0	0-8	1	
TOTAL AVG.NO.ORGANISMS	23		56		12		66		19.8		181	
TOTAL NO. OF TAXA	5		3		1		12		14		12	
AVG. NO. OF TAXA	6		3		1		12		6.0		12	
NO. OF SAMPLES	Qual.		Qual.		Qual.		Qual.		5		Qual.	

TABLE 1.1 (continued)

STATIONS TAXA	126.4				125.3				124.3			
	A Avg.	B Range	A Avg.	B Range	A Avg.	B Range	A Avg.	B Range	A Avg.	B Range	A Avg.	B Range
Ephemeroptera												
Ephemeridae												
Others									0.4	0-1		
Trichoptera												
Psychomyiidae												
Leptoceridae	0.5	0-1					1.0	0-2				
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	164.8	13-573	15.0	5-26	13.8	2-22	22.2	0-48	18.2	11-38	10.8	2-25
Others			0.8	0-3			0.8	0-4	0.2	0-1		
Amphipoda	1.5	0-4	5.4	2-12	0.2	0-1	3.8	0-6	0.6	0-1		
Isopoda	3.2	1-7	23.0	12-39			0.6	0-2	11.2	3-21		
Gastropoda												
Pulmonata							1.0	0-3	0.2	0-1		
Branchiata	4.0	0-8	10.4	8-15			7.8	6-10	0.8	0-3		
Pelecypoda												
Sphaeriidae	4.0	0-7	1.6	1-4			4.8	0-9	0.8	0-2		
Unionidae							3.6	0-11	0.6	0-3		
Hirudinea			0.6	0-1								
Oligochaeta												
Tubificidae	19.8	5-62	18.0	0-30			33.0	10-60	15.6	3-34		
Lumbriculidae	7.0	0-24	2.6	0-6								
Naididae	5.0	0-20	2.6	0-10								
Others	4.2	2-10	1.6	0-4			0.6	0-2				
TOTAL AVG.NO.ORGANISMS	213.0		81.6		14.0		79.2		48.6		10.8	
TOTAL NO. OF TAXA	13		20		2		19		11		1	
AVG. NO. OF TAXA	7.0		10.6		1.2		9.4		5.6		1.0	
NO. OF SAMPLES	4		5		5		5		5		4	

TABLE 1.1 (continued)

STATIONS TAXA	123.5 B		122.2				120.6				120.0 A	
	Avg.	Range	A Avg.	B Range	Avg.	B Range	A Avg.	B Range	Avg.	B Range	Avg.	Range
Ephemeroptera												
Ephemeridae												
Others												
Trichoptera												
Psychomyiidae												
Leptoceridae												
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	102	25-171	0.2	0-1	24.6	6-51			7.4	1-18	34.2	4-64
Others			0.2	0-1	2.8	0-14	0.3	0-1				
Amphipoda	0.2	0-1	0.2	0-1	0.4	0-1	2.3	0-7	0.2	0-1	1.0	0-2
Isopoda	0.8	0-4										
Gastropoda												
Pulmonata												
Branchiata	2.2	0-3	0.2	0-1	0.6	0-2	1.0	0-1	12.6	0-22		
Pelecypoda												
Sphaeriidae			1.0	0-2	2.2	0-4	3.7	0-5	3.6	0-9	2.2	0-9
Unionidae			1.8	0-6			1.3	0-2	0.2	0-1	0.8	0-3
Hirudinea												
Oligochaeta												
Tubificidae	55.0	15-186			3.0	0-6	0.3	0-1	1.8	0-4	3.5	0-8
Lumbriculidae			0.2	0-1	0.2	0-1					1.5	0-6
Naididae												
Others					0.4	0-1						
TOTAL AVG.NO.ORGANISMS	160.2		3.8		34.2		8.9		25.8		43.2	
TOTAL NO. OF TAXA	7		9		9		8		7		6	
AVG. NO. OF TAXA	3.6		2.6		4.0		4.0		3.6		3.8	
NO. OF SAMPLES	5		5		5		3		5		4	

TABLE 1.1 (continued)

STATIONS TAXA	119.6 C		118.1				114.1				113.1	
	Avg.	Range	A Avg.	B Range	Avg.	Range	A Avg.	B Range	Avg.	Range	A Avg.	Range
Ephemeroptera												
Ephemeridae												
Others					0.2	0-1						
Trichoptera												
Psychomyiidae							0.6	0-2			0.2	0-1
Leptoceridae			1.4	0-4							0.5	0-2
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	5.0	4-10	0.6	0-3	48.2	14-110			2.8	1-5	49.0	1-185
Others												
Amphipoda	2.8	1-9	2.2	1-4	0.2	0-1	17.2	0-77			4.5	0-16
Isopoda							0.4	0-2	0.2	0-1	2.5	0-11
Gastropoda												
Pulmonata			0.4	0-1			2.0	0-7			0.3	0-1
Branchiata	1.2	0-4	1.6	0-3	2.0	1-6	44.6	13-73	0.8	0-4	23.0	1-74
Pelecypoda												
Sphaeriidae	7.2	0-26	5.6	0-11	0.2	0-1	37.6	2-104	2.4	2-104	25.0	0-63
Unionidae			4.4	1-15			5.8	1-9			2.0	0-3
Hirudinea							0.4	0-2			1.2	0-2
Oligochaeta												
Tubificidae	0.4	0-1	30.4	7-50	11.6	1-48	18.6	0-74	115.4	3-234	38.0	1-102
Lumbriculidae	0.4	0-1	0.2	0-1			0.2	0-1			0.2	0-1
Naididae												
Others	0.4	0-1	1.0	0-2			0.4	0-1			1.0	0-3
TOTAL AVG.NO.ORGANISMS	17.4		47.8		62.4		127.8		121.6		147.4	
TOTAL NO. OF TAXA	9		17		7		21		7		21	
AVG. NO. OF TAXA	3.8		8.8		3.8		9.6		4.0		8.6	
NO. OF SAMPLES	5		5		5		5		5		4	

TABLE 1.1 (continued)

STATIONS TAXA	113.1 B		112.1 B		111.3				110.3 B		107.7 A	
	Avg.	Range	Avg.	Range	A	B	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae												
Others												
Trichoptera												
Psychomyiidae					0.2	0-1	0.2	0-1				
Leptoceridae												
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	19.2	0-44	0.5	0-2	0.6	0-2	9.2	3-21	1.8	0-4	0.4	0-1
Others												
Amphipoda	0.2	0-1	5.0	0-20	3.4	1-7	0.2	0-1	0.2	0-1	3.4	0-15
Isopoda	0.6	0-2	14.8	0-54			5.2	0-12	9.2	3-18		
Gastropoda												
Pulmonata					1.6	0-18					0.4	0-1
Branchiata	46.2	29-86	6.2	0-12	24.4	17-40	20.8	15-32	2.4	0-6	2.2	0-2
Pelecypoda												
Sphaeriidae	27.4	4-55	3.2	0-8	87.8	45-208	17.0	15-19	16.2	3-35	8.6	1-20
Unionidae											2.6	0-5
Hirudinea	0.4	0-1	0.2	0-1	8.2	3-8	1.2	0-3	0.2	0-1	0.2	0-1
Oligochaeta												
Tubificidae	24.6	0-60	17.5	4-45	1.4	0-3	147.4	20-244	127.0	25-165	85.2	11-155
Lumbriculidae			5.2	0-21					0.2	0-1		
Naididae												
Others			1.0	0-4	127.6				0.2	0-1	1.4	0-3
TOTAL AVG.NO.ORGANISMS	118.6		55.1		26.0		201.2		158.4		104.4	
TOTAL NO. OF TAXA	10		11		16		11		10		14	
AVG. NO. OF TAXA	5.2		4.8		9.4		6.0		6.0		6.2	
NO. OF SAMPLES	5		4		5		5		5		5	

TABLE 1.1 (continued)

STATIONS TAXA	107.7 B		105.5 C		103.9				101.9 B		101.1 B	
	Avg.	Range	Avg.	Range	A	Range	B	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae												
Others							3.8	3-9			0.8	0-2
Trichoptera												
Psychomyiidae							0.4	0-2				
Leptoceridae							0.2	0-1				
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	3.0	0-8	1.0	0-5			4.4	0-8	15.0	12-16	24.4	0-53
Others					0.2	0-1	0.2	0-1				
Amphipoda			0.4	0-1	1.0	0-2	0.4	0-2	4.0	2-8	0.2	0-1
Isopoda			0.8	0-4					3.5	0-8	9.6	0-30
Gastropoda												
Pulmonata												
Branchiata	1.8	0-8	0.8	0-3	1.0	0-2	0.4	0-2			1.8	0-4
Pelecypoda												
Sphaeriidae	2.8	0-10	15.4	0-36	5.2	0-11	6.6	2-11	5.5	0-14	1.8	0-6
Unionidae					5.6	1-11					0.2	0-1
Hirudinea	0.2	0-1							0.5	0-2	0.4	0-2
Oligochaeta												
Tubificidae	42.0	18-52	12.6	2-34	1.6	0-3	46.2	15-	42.0	0-108	129.0	0-332
Lumbriculidae			0.8	0-4				107				
Naididae			0.6	0-3								
Others			4.0	1-7								
TOTAL AVG.NO.ORGANISMS	49.8		36.4		14.6		62.6		70.5		168.2	
TOTAL NO. OF TAXA	5		16		9		12		7		9	
AVG. NO. OF TAXA	3.2		7.0		4.4		5.2		4.5		4.8	
NO. OF SAMPLES	5		5		5		5		4		5	

STATIONS TAXA	101.1		100.0				97.8				96.6	
	C		A		B		A		B		C	
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae												
Others									0.2	0-1		
Trichoptera												
Psychomyiidae			0.2									
Leptoceridae	0.2	0-1							1.0	0-4		
Others												
Neuroptera												
Odonata					3.2	0-15	0.2	0-1	1.4	0-5		
Diptera												
Chironomidae			0.2	0-1								
Others												
Amphipoda	1.8	0-4	1.0	0-2			2.6	0-5	0.8	0-3		
Isopoda	1.4	0-3	0.2	0-1	18.8	0-87						
Gastropoda												
Pulmonata	0.4	0-1	2.0	0-4					0.2	0-1		
Branchiata	3.0	0-5	6.8	2-11	1.0	0-3	2.2	0-6	0.4	0-2	0.2	0-1
Pelecypoda												
Sphaeriidae	114.0	36-177	143.0	75-193	3.0	1-9	63.6	15-144	37.6	19-87	43.4	0-113
Unionidae			3.6	2-5			2.0	0-4			0.8	0-2
Hirudinea			0.2	0-1								
Oligochaeta												
Tubificidae	45.6	13-85	2.6	1-4	91.6	0-413	8.0	1-16	2.0	0-5		
Lumbriculidae	13.8	0-57	0.2	0-1							0.2	0-1
Naididae									1.0	0-4		
Others	0.8	0-3							0.2	0-1	1.8	0-9
TOTAL AVG.NO.ORGANISMS	181.0		160.0		117.6		78.6		44.8		46.4	
TOTAL NO. OF TAXA	15		18		5		10		16		5	
AVG. NO. OF TAXA	9.4		10.2		3.0		6.0		5.8		1.8	
NO. OF SAMPLES	5		5		5		5		5		5	

TABLE 1.1 (continued)

STATIONS TAXA	95.1				93.2		90.7					
	A Avg.	B Range	Avg.	Range	C Avg.	Range	A Avg.	Range	C Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae												
Others							2.2	0-11				
Trichoptera												
Psychomyiidae												
Leptoceridae							0.2	0-1				
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae			0.6	0-3	0.6	0-2	23.4	4-60	3.2	0-6		
Others												
Amphipoda	0.6	0-1			0.2	0-1	1.2	0-4				
Isopoda					0.8	0-4	4.6	0-19	4.8	2-8		
Gastropoda												
Pulmonata												
Branchiata	1.0	0-4			1.2	0-4	0.2	0-1	1.4	0-4		
Pelecypoda												
Sphaeriidae	10.6	3-18	14.2	6-29	64.6	0-315	0.6	0-1	51.2	0-132		
Unionidae	6.2	3-12	0.4	0-1								
Hirudinea					1.8	0-4			1.6	0-4		
Oligochaeta												
Tubificidae	6.4	0-27	28.6	17-58	2.2	0-7	34.2	0-135	566.8	220-		
Lumbriculidae	0.4	0-2			0.4	0-2				794		
Naididae					0.4	0-2						
Others	0.8	0-3										
TOTAL AVG.NO.ORGANISMS	26.0		43.8		72.2		66.6		629.0			
TOTAL NO. OF TAXA	12		6		14		10		7			
AVG. NO. OF TAXA	5.8		3.4		4.0		5.0		5.0			
NO. OF SAMPLES	5		5		5		5		5			

TABLE 1.1 (continued)

STATIONS		90.7		84.8				78.8				71.8	
TAXA	B	Range	C	Range	A	Range	C	Range	B	Range	C	Range	
Ephemeroptera													
Ephemeridae													
Others													
Trichoptera													
Psychomyiidae					2.4	0-5	0.2	0-1					
Leptoceridae													
Others													
Neuroptera													
Odonata													
Diptera													
Chironomidae	86.6	91-103			10.4	0-21	7.4	0-36	10.5	7-15	4.0	0-8	
Others					2.8	1-6							
Amphipoda			3.2	0-6	3.0	1-5	0.6	0-2	1.5	1-2	52.8	27-89	
Isopoda	5.4	0-11			8.4	2-23			0.5	0-1	0.4	0-1	
Gastropoda							0.4	0-1			0.2	0-1	
Pulmonata													
Branchiata					1.2	0-3	14.2	0-37			1.6	0-5	
Pelecypoda													
Sphaerididae	2.2	0-9	3.0	0-5	1.0	0-2	238.8	88-461	4.5	1-12	33.4	10-100	
Unionidae					0.8	0-2	0.2	0-1			0.6	0-1	
Hirudinea			5.5	0-12	0.8	0-2	2.4	0-4	6.5	3-11			
Oligochaeta													
Tubificidae	106.6	0-257	7.2	0-24	5.4	0-15	73.6	0-342	330.2	217-489	37.4	9-66	
Lumbriculidae			0.5	0-2			0.2	0-1			0.4	0-2	
Naididae													
Others	0.2	0-1			0.6	0-1	0.6	0-3			5.6	1-20	
TOTAL AVG.NO.ORGANISMS	201.0		19.4		36.8		338.6		354.7		132.4		
TOTAL NO. OF TAXA	6		8		14		17		7		16		
AVG. NO. OF TAXA	3.2		4.0		8.4		7.6		3.8		9.2		
NO. OF SAMPLES	5		4		5		5		4		5		

TABLE 1.1 (continued)

STATIONS TAXA	70.2				68.5		67.7		67.6		67.5	
	A Avg.	B Range	A Avg.	B Range	A Avg.	Range	A Avg.	Range	A Avg.	Range	A Avg.	Range
Ephemeroptera												
Ephemeridae	0.2	0-1							0.2	0-1		
Others												
Trichoptera												
Psychomyiidae			0.2	0-1	1.0	0-2						
Leptoceridae			0.2	0-1								
Others	0.4	0-1										
Neuroptera												
Odonata												
Diptera												
Chironomidae			3.0	0-5	0.8	0-4	14.0	2-19	56.8	67-88	11.6	5-25
Others			0.2	0-1								
Amphipoda	0.6	0-1	4.8	0-8	9.0	0-39	6.0	1-15	1.6	0-7		
Isopoda							12.6	2-20	3.2	0-16		
Gastropoda												
Pulmonata	0.6	0-2	2.6	1-4	0.2	0-1						
Branchiata	0.2	0-1										
Pelecypoda												
Sphaeriidae	5.2	1-9	10.3	34-224	2.4	0-5	1.8	0-5	8.6	3-16		
Unionidae	8.2	6-14	4.6		1.0	0-2						
Hirudinea	0.2	0-1	2.2	1-4								
Oligochaeta												
Tubificidae	3.6	0-15	5.8	0-24	0.2	0-1	34.2	6-88	219.2	59-348	2.0	0-4
Lumbriculidae	0.8	0-2	0.4	0-2								
Naididae												
Others			0.6	0-2								
TOTAL AVG.NO.ORGANISMS	20.0		124.9		14.6		68.6		289.4		13.6	
TOTAL NO. OF TAXA	15		19		8		6		6		2	
AVG. NO. OF TAXA	6.0		8.2		4.2		5.2		3.8		1.6	
NO. OF SAMPLES	5		5		5		5		5		5	

TABLE 1.1 (continued)

STATIONS TAXA	66.1				63.8				62.7		59.7	
	Avg. A	Range B	Avg. B	Range	Avg. A	Range B	Avg. B	Range	Avg. C	Range	Avg. A	Range
Ephemeroptera												
Ephemeridae												
Others												
Trichoptera												
Psychomyiidae			0.2	0-1	0.2	0-1						
Leptoceridae			0.4	0-2	0.2	0-1	0.6	0-3				
Others							0.2	0-1				
Neuroptera												
Odonata												
Diptera												
Chironomidae	28.0	19-38	5.6	0-11	5.3	4-12	20.2	17-31			2.0	0-3
Others			0.4	0-2								
Amphipoda					0.2	0-1						
Isopoda	3.5	0-13	0.2	0-1	32.4	1-65	1.0	0-2	0.8	0-2	112.2	61-184
Gastropoda												
Pulmonata	0.8	0-2			0.4	0-2			0.2	0-1		
Branchiata	17.8	4-36	0.4	0-2	0.2	0-1	7.2	3-16	70.2	16-110	2.8	0-5
Pelecypoda												
Sphaeriidae	732.8	436-891	2.4	0-6	119.2	27-208	26.6	7-41	170.8	26-347		
Unionidae			0.2	0-1								
Hirudinea			0.4	0-1	2.0	0-5	0.4	0-1	3.0	0-11	0.2	0-1
Oligochaeta												
Tubificidae	38.5	4-72	46.0	7-73	37.2	13-75	150.0	4-369	221.0	16-585	17.8	3-36
Lumbriculidae											1.0	0-2
Naididae												
Others	0.8	0-3			0.2	0-1	0.4	0-1	3.0	3-5		
TOTAL AVG.NO.ORGANISMS	822.2		56.2		198.0		206.6		469.0		136.0	
TOTAL NO. OF TAXA	11		9		13		13		13		7	
AVG. NO. OF TAXA	7.2		5.6		6.4		6.4		8.0		4.5	
NO. OF SAMPLES	4		4		5		5		4		4	

TABLE 1.1 (continued)

STATIONS TAXA	59.7 B		A		58.9 C		B		57.0 C		54.3 A	
	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
Ephemeroptera												
Ephemeridae			0.2	0-1								
Others			1.2	0-4								
Trichoptera												
Psychomyiidae			0.6	0-2	0.2	0-1			0.4	0-2		
Leptoceridae											2.7	1-5
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	10.6	3-21	8.6	2-18	2.0	1-4	7.6	5-12	7.0	5-8	33.7	23-40
Others	0.4	0-2										
Amphipoda			97.6	56-139	0.8	0-2	0.6	0-2			9.0	5-14
Isopoda			10.6	1-24	0.5	0-2	2.6	1-6	0.8	0-4	1.0	0-2
Gastropoda												
Pulmonata			21.6	2-49							0.3	0-1
Branchiata	0.6	0-1	24.2	10-41	14.8	1-29	6.4	3-8	0.2	0-1	4.7	3-6
Pelecypoda												
Sphaeriidae	0.8	0-2	2.6	0-7	30.2	6-81	195.2	91-264	3.2	1-6	57.7	20-99
Unionidae					1.5	0-4			0.2	0-1	6.7	4-9
Hirudinea			0.8	0-1	3.2	0-9			0.2	0-1	2.3	1-4
Oligochaeta												
Tubificidae	7.2	2-23	12.6	3-23	219.8	125-275	130.0	41-374	2.0	0-5	205.7	132-312
Lumbriculidae												
Naididae												
Others			3.8	1-8	4.2	0-13						
TOTAL AVG.NO.ORGANISMS	19.6		181.8		277.2		342.4		14.0		323.8	
TOTAL NO. OF TAXA	6		20		17		11		9		17	
AVG. NO. OF TAXA	3.0		13.2		9.5		8.0		3.4		15.0	
NO. OF SAMPLES	5		5		4		5		5		3	

TABLE 1.1 (continued)

STATIONS TAXA	54.3				51.3				47.3			
	Avg. C	Range	Avg. B	Range	Avg. A	Range	Avg. B	Range	Avg. A	Range	Avg. B	Range
Ephemeroptera												
Ephemeridae												
Others												
Trichoptera												
Psychomyiidae	0.2	0-1										
Leptoceridae												
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae					17		3.0	1-5	1.3	0-2		
Others												
Amphipoda	5.2	1-13	4.8	0-16			19.5	3-36				
Isopoda					1							
Gastropoda												
Pulmonata	0.4	0-1	1.0	0-3			1.0	0-2	0.3	0-1		
Branchiata	37.0	0-74	8.4	0-20	2				0.3	0-1		
Pelecypoda												
Sphaeriidae	53.6	1-67	1.4	0-7	1		6.5	0-13			0.7	0-2
Unionidae	1.6	0-7	4.4	2-9	4		1.5	1-2	4.0	3-5	4.0	3-5
Hirudinea					1				0.3	0-1	2.7	1-5
Oligochaeta												
Tubificidae	5.4	0-12	34.0	11-72	66		93.0	71-115			26.3	6-47
Lumbriculidae	5.2	1-11	6.8	0-23			3.5	0-7	0.3	0-1	1.7	0-3
Naididae												
Others	1.8	0-9	0.4	0-2			1.0	0-2	0.3	0-1		
TOTAL AVG.NO.ORGANISMS			61.2		92		129.0		6.8		35.4	
TOTAL NO. OF TAXA	18		15		11		13		7		9	
AVG. NO. OF TAXA	9.4		5.4		11		9		3.3		6.3	
NO. OF SAMPLES	5		5		1		2		3		3	

TABLE 1.1 (continued)

STATIONS TAXA	41.2						39.0					
	Avg. A	Range	Avg. C	Range	Avg. B	Range	Avg. A	Range	Avg. C	Range	Avg. B	Range
Ephemeroptera			1				10.2	9-13				
Ephemeridae												
Others												
Trichoptera											5.7	3-10
Psychomyiidae												
Leptoceridae												
Others												
Neuroptera												
Odonata												
Diptera												
Chironomidae	6		9		7		1.4	0-3	6.2	3-13	10.0	9-11
Others												
Amphipoda											19.3	2-41
Isopoda			1		1						12.3	3-34
Gastropoda												
Pulmonata							0.2	0-1			0.3	0-1
Branchiata					4		0.2	0-1	1.8	0-4	3.7	2-5
Pelecypoda												
Sphaeriidae	1				6		0.2	0-1	76.4	12-125	0.3	0-1
Unionidae							2.0	0-4			1.0	0-2
Hirudinea					1		0.2	0-1	1.6	1-2	7.7	7-8
Oligochaeta												
Tubificidae	161		128		133				147.6	87-245	113.0	61-195
Lumbriculidae												
Naididae												
Others			1								0.7	0-1
TOTAL AVG.NO.ORGANISMS	168		141		152		14.4		233.6		174.0	
TOTAL NO. OF TAXA	4		7		7		9		11		18	
AVG. NO. OF TAXA	4		7		7		3.8		6.4		12.3	
NO. OF SAMPLES	1		1		1		5		5		3	

TABLE 1.2

ARTIFICIAL SUBSTRATE BOTTOM FAUNA COLLECTIONS
OTTAWA RIVER, 1968 AND 1969
NUMBERS OF ORGANISMS PER SAMPLE

Note:

1. For information on depth, current velocities and sampling dates, reference should be made to Table 1.5.
2. Complete list of taxa has not been presented, for further information, reference should be made to Ottawa River data file, Biology Branch, OWRC.
3. Stations are designated by river miles upstream from the confluence of Des Prairies River with the St. Lawrence River (RM 0.0) as illustrated in the zone maps in the Introduction; A - stations near the south shore; B - stations near the north shore; and C - stations at mid-river.

TABLE 1.2

ARTIFICIAL SUBSTRATE BOTTOM FAUNA COLLECTIONS
OTTAWA RIVER, 1968 AND 1969
NUMBER OF ORGANISMS PER SAMPLE

STATIONS TAXA	371.7 A	371.4 A	371.4 B	370.6 C	368.4 A	367.4 B
Plecoptera						
Ephemeroptera						
Ephemeridae	10					
Heptageniidae	7					
Baetidae						
Others						
Trichoptera						
Hydropsychidae		25				
Psychomyidae	59					
Leptoceridae						
Others						
Odonata					1	
Diptera						
Chironomidae	12	166	4	211	4	
Others			4			
Coleoptera	1					
Amphipoda	9	13	6	42	113+	27
Isopoda		6				
Decapoda	1	1				
Gastropoda						
Pulmonata	85	43	4	1	3	1
Branchiata						
Pelecypoda						
Sphaeriidae					2	
Unionidae						
Hirudinea						
Erpobdellidae		1			5	1
Glossiphoniidae					24	
Others						
Oligochaeta						
Tubificidae		9	1			
Lumbriculidae	1	1		2		
Naididae	9			4	4	59
Others			6			
TOTAL ORGANISMS	194	265	25	260	156	88
TOTAL TAXA	15	11	7	5	14	4

TABLE 1.2 (continued)

STATIONS TAXA	362.2	356.1	352.9	352.9	347.3	347.3
	B	B	A	B	A	B
Plecoptera						
Ephemeroptera						
Ephemeridae		12		18		
Heptageniidae					2	1
Baetidae						
Others						
Trichoptera						
Hydropsychidae						
Psychomyidae	2					
Leptoceridae		1				
Others	1					
Odonata			1	1		
Diptera						
Chironomidae	2	6				17
Others						
Coleoptera		5	1			1
Amphipoda	47+	21+	1	5	20	33
Isopoda					1	2
Decapoda	3					1
Gastropoda						
Pulmonata	10	8	35	14	47	73
Branchiata			6	1	54	1
Pelecypoda						
Sphaeriidae		2		1		
Unionidae						
Hirudinea						
Erpobdellidae			1		3	2
Glossiphoniidae				1		1
Others						
Oligochaeta						
Tubificidae						
Lumbriculidae						
Naididae	2	1	10	8	72	31
Others	51	17	49		17	2
TOTAL ORGANISMS	118+	73+	104	49	216	165
TOTAL TAXA	12	13	14	12	13	17

TABLE 1.2 (continued)

STATIONS TAXA	344.3	342.0	342.0	342.0	333.9	325.1
	C	A	B	C	A	B
Plecoptera						
Ephemeroptera						
Ephemeridae						
Heptageniidae	2	64	28		1	11
Baetidae						
Others		2				
Trichoptera						
Hydropsychidae						
Psychomyidae			16			157
Leptoceridae						
Others					1	
Odonata	1					
Diptera						
Chironomidae			2			3
Others						
Coleoptera			1			
Amphipoda	2	52	6	9	28	29
Isopoda		5	1	9	3	42
Decapoda		4	1		6	
Gastropoda						
Pulmonata	5	9	10	30	4	1
Branchiata					1	
Pelecypoda						
Sphaeriidae						
Unionidae						
Hirudinea						
Erpobdellidae		1				1
Glossiphonidae			1		1	
Others						
Oligochaeta						
Tubificidae						
Lumbriculidae						
Naididae		1	2	4		23
Others		4	74	9	3	4
TOTAL ORGANISMS	10	142	142	61	48	271
TOTAL TAXA	4	12	15	7	9	12

TABLE 1.2 (continued)

STATIONS TAXA	195.8 B	192.3 B	191.9 B (a)	191.9 B (b)	191.6 A	190.4 B
Plecoptera						
Ephemeroptera						
Ephemeridae						
Heptageniidae		3	2	1		5
Baetidae						
Others						
Trichoptera						
Hydropsychidae						
Psychomyidae	2	2	1	1		
Leptoceridae	3	2	1		1	
Others						
Odonata		1		1		1
Diptera						
Chironomidae			1		4	
Others					4	
Coleoptera						
Amphipoda	1	2	2		1	8
Isopoda						
Decapoda	1		2	1		2
Gastropoda						
Pulmonata		23	3	26		23
Branchiata		1		9	2	59
Pelecypoda						
Sphaeriidae		2	1	9	4	27
Unionidae						
Hirudinea				2		
Erpobdellidae						
Glossiphonidae						
Others						
Oligochaeta						
Tubificidae			2		13	
Lumbriculidae					4	
Naididae		1				
Others	4	14	47	2	30	11
TOTAL ORGANISMS	11	51	62	52	63	136
TOTAL TAXA	6	11	10	10	9	9

TABLE 1.2 (continued)

STATIONS TAXA	188.5	188.5	129.3	129.3	129.2	129.2
	A	B	A	C	A	D
Plecoptera						5
Ephemeroptera						
Ephemeridae					4	24
Heptageniidae	19	2	7	18	38	39
Baetidae			6	2	9	27
Others						
Trichoptera						
Hydropsychidae	4					7
Psychomyidae	81	44	3			30
Leptoceridae						
Others						1
Odonata	1					
Diptera						
Chironomidae	1				1	1
Others						1
Coleoptera						
Amphipoda	16	24	4	12	53	4
Isopoda			1	1	32	2
Decapoda	3					
Gastropoda						
Pulmonata		15	2	6	16	7
Branchiata		3	2		164	18
Pelecypoda						
Sphaeriidae						
Unionidae						
Hirudinea	1					
Erpobdellidae						
Glossiphonidae					12	
Others						
Oligochaeta						
Tubificidae						
Lumbriculidae						
Naididae			3	6	1	
Others		19		29	66	8
TOTAL ORGANISMS	126	107	28	74	396	174
TOTAL TAXA	10	8	10	8	15	19

TABLE 1.2 (continued)

STATIONS TAXA	129.1	129.1	129.1	128.7	128.3	127.8
	A ₁	A ₂	B	A	A	A
Plecoptera		2				
Ephemeroptera						
Ephemeridae						13
Heptageniidae	14	12	2	61	24	43
Baetidae	7	1		2		
Others						
Trichoptera						
Hydropsychidae						135
Psychomyidae		6	46	29	2	15
Leptoceridae						
Others	2					22
Odonata						1
Diptera						
Chironomidae	19	1	11	1		39
Others						
Coleoptera		2	1	56		2
Amphipoda	9	6	17	20	2	79
Isopoda						
Decapoda				1		
Gastropoda						
Pulmonata	7	7	52	5	3	60
Branchiata	89	64	11	88	230	115
Pelecypoda						
Sphaeriidae						
Unionidae						
Hirudinea						
Erpobdellidae						
Glossiphonidae					3	
Others						
Oligochaeta						
Tubificidae				1		
Lumbriculidae			1			
Naididae			48			
Others		7	96	43	26	39
TOTAL ORGANISMS	147	108	285	307	290	563
TOTAL TAXA	13	13	14	18	8	23

TABLE 1.2 (continued)

STATIONS TAXA	127.4	126.4	126.4	123.5	122.2	122.2
	B	A	B	B	A	B
Plecoptera						
Ephemeroptera						
Ephemeridae						
Heptageniidae	1					1
Baetidae						
Others						
Trichoptera						
Hydropsychidae	1			1	58	1
Psychomyidae	4	2	2		12	3
Leptoceridae						
Others					16	1
Odonata	3		1			
Diptera						
Chironomidae	17	7	2	2		36
Others						
Coleoptera	1		1			
Amphipoda	66	28	76	25		1
Isopoda	72	6	3		4	
Decapoda						
Gastropoda						
Pulmonata	98	14	17	53	14	71
Branchiata	65	2	4	75	3	8
Pelecypoda						
Sphaeriidae						
Unionidae					1	
Hirudinea						
Erpobdellidae						
Glossiphonidae	41	7		4		
Others						
Oligochaeta						
Tubificidae				1		
Lumbriculidae						
Naididae	36					26
Others	206	103	21	349	1	8
TOTAL ORGANISMS	611	169	127	510	109	156
TOTAL TAXA	23	13	16	15	13	13

TABLE 1.2 (continued)

STATIONS TAXA	120.6	120.6	118.1	113.1	113.1	122.2
	A	B	A	A	B	A
Plecoptera						1
Ephemeroptera						
Ephemeridae	7	5	37		4	3
Heptageniidae		4	6	94	14	43
Baetidae						
Others						
Trichoptera						
Hydropsychidae	45	3	20	22	25	60
Psychomyidae	4	4	6	2		1
Leptoceridae	3	1	4	1	1	1
Others	20	1	10			
Odonata						
Diptera						
Chironomidae	139	42	163	150	268	123
Others				8		11
Coleoptera						
Amphipoda	232	1	152	24	4	11
Isopoda	28		55			
Decapoda						
Gastropoda						
Pulmonata	5	1	18			
Branchiata	4		12	3		5
Pelecypoda						
Sphaeriidae			5			
Unionidae						
Hirudinea						
Erpobdellidae						
Glossiphonidae	4					
Others						
Oligochaeta						
Tubificidae						
Lumbriculidae						
Naididae	22	8	3			
Others	60	12	25	1		
TOTAL ORGANISMS	573	82	516	305	316	259
TOTAL TAXA	24	15	21	13	8	14

TABLE 1.2 (continued)

STATIONS TAXA	112.2	111.3	111.3	110.3	107.7	106.7
	B	A	B	B	B	C
Plecoptera					2	2
Ephemeroptera						
Ephemeridae	3	5	6	2	19	2
Heptageniidae	9	61	20	3	3	7
Baetidae						
Others						
Trichoptera						
Hydropsychidae	3	49	34	19	11	8
Psychomyidae		4	7	7	13	
Leptoceridae		2	1	2		2
Others					3	
Odonata						
Diptera						
Chironomidae	347	390	580	430	420	100
Others	2	1	2			
Coleoptera				1		
Amphipoda	15	18	52	20	23	67
Isopoda				1	3	
Decapoda						
Gastropoda						
Pulmonata			2			
Branchiata	5					
Pelecypoda						
Sphaeriidae						
Unionidae						
Hirudinea						
Erpobdellidae						
Glossiphonidae						
Others						
Oligochaeta						
Tubificidae						
Lumbriculidae						
Naididae			100+	10	2	
Others			1		3	
TOTAL ORGANISMS	384	530	805+	495	502	188
TOTAL TAXA	10	16	20	14	16	18

TABLE 1.2 (continued)

STATIONS TAXA	103.9 A	103.9 B	101.9 A	100.2 A	100.0 C	97.8 C(2')
Plecoptera		3				
Ephemeroptera						
Ephemeridae	16	65	1	2	1	33
Heptageniidae		3		5		20
Baetidae						
Others						
Trichoptera						
Hydropsychidae	24	72	5	4		60
Psychomyidae	8	21	8	2		4
Leptoceridae				1		
Others	6	6			1	3
Odonata					1	
Diptera						
Chironomidae		161				241
Others		2				7
Coleoptera						
Amphipoda	86	33	23	630	16	56
Isopoda	15			1		
Decapoda						
Gastropoda						
Pulmonata			21	8	16	
Branchiata	1			16	4	
Pelecypoda						
Sphaeriidae					6	
Unionidae						
Hirudinea						
Erpobdellidae	1			1		
Glossiphonidae	1		2	1	9	
Others						
Oligochaeta						
Tubificidae					6	
Lumbriculidae					1	
Naididae		175	564	82	84	167
Others	2	4	71	2	117	1
TOTAL ORGANISMS	160	545	695	755	262	592
TOTAL TAXA	17	18	12	16	16	20

TABLE 1.2 (continued)

STATIONS TAXA	97.8 C(18')	69.9 A(2')	69.9 A(10')	70.0 B(2')	70.0 B(26')	68.4 A(2')
Plecoptera				3	1	8
Ephemeroptera						
Ephemeridae				1		
Heptageniidae	27			1	2	
Baetidae	1	2		4	1	
Others						
Trichoptera						
Hydropsychidae	5				2	
Psychomyidae	11		3	1	5	8
Leptoceridae		3	20	1	7	2
Others					1	
Odonata						1
Diptera						
Chironomidae	2	103		102	21	19
Others						
Coleoptera					1	
Amphipoda	305	4	10	41	20	161
Isopoda						
Decapoda	4					
Gastropoda						
Pulmonata	50					
Branchiata			37			
Pelecypoda						
Sphaeriidae	3					
Unionidae						
Hirudinea						
Erpobdellidae						
Glossiphonidae	10					
Others						
Oligochaeta						
Tubificidae						
Lumbriculidae						
Naididae		1			107	
Others	77		1			
TOTAL ORGANISMS	495	113	71	154	168	200
TOTAL TAXA	16	7	6	11	14	8

TABLE 1.2 (continued)

STATIONS TAXA	68.4 A(10')	68.3 A(2')	68.1 B(10')	68.0 A(2')	67.7 A(13')	66.1 B(25')
Plecoptera						
Ephemeroptera						
Ephemeridae						
Heptageniidae						1
Baetidae	1		1			
Others						
Trichoptera						
Hydropsychidae			2			1
Psychomyidae	10		1	11	5	9
Leptoceridae	3					1
Others						
Odonata		1				
Diptera						
Chironomidae		8	162	373		24
Others			2			4
Coleoptera						1
Amphipoda	52	12	2	258		22
Isopoda		159	18	135	87	99
Decapoda						
Gastropoda						
Pulmonata					6	7
Branchiata	5				75	12
Pelecypoda						
Sphaeriidae					3	
Unionidae						
Hirudinea						
Erpobdellidae						
Glossiphonidae						
Others						
Oligochaeta						
Tubificidae		2				
Lumbriculidae		4				
Naididae		10	14		13	57
Others			1		12	18
TOTAL ORGANISMS	71	196	203	777	201	256
TOTAL TAXA	5	8	9	5	8	15

TABLE 1.2 (continued)

STATIONS TAXA	66.1	63.4	67.8	63.8	63.8	60.2
	B(27')	A(5')	B(2')	B(2')	B(2')	A(2')
Plecoptera	2					
Ephemeroptera						
Ephemeridae						
Heptageniidae	5		1		1	
Baetidae						
Others						
Trichoptera						
Hydropsychidae	4					
Psychomyidae	60		9	6	3	
Leptoceridae	1	2		1	13	12
Others	1					
Odonata				1		
Diptera						
Chironomidae	2	1		1	3	5
Others						
Coleoptera						
Amphipoda	41		16	21	244	9
Isopoda		477			10	8
Decapoda	1					
Gastropoda						
Pulmonata	3	10			13	7
Branchiata	2	25			63	632
Pelecypoda						
Sphaeriidae	11	24				
Unionidae						
Hirudinea						
Erpobdellidae						
Glossiphonidae		49				
Others						
Oligochaeta						
Tubificidae						
Lumbriculidae						
Naididae	p*	9			14	2
Others	5	22			2	28
TOTAL ORGANISMS	138	619	26	30	367	703
TOTAL TAXA	14	13	3	5	13	10

* present

TABLE 1.3

CONCENTRATION (asu/ml) OF SUSPENDED MATERIAL
OTTAWA RIVER, 1969

Note:

Stations are designated by river miles measured upstream from the confluence of the Des Prairies River with the St. Lawrence River (RM 0.0) as illustrated on the Zone Maps in the Introduction;

- A stations near the south shore,
- B stations near the north shore,
- C stations near mid-river,
- ABC composite sample from above three.

TABLE 1.3

CONCENTRATIONS (asu/ml) OF SUSPENDED MATERIAL
OTTAWA RIVER, 1969

Station	Date	Algae	Zooplankton	Wood Fibre	Sewage Fungus	Detritus	Total
381.7 ABC	31/7/69	0.6	4.4	0.3	0.0	5.6	10.9
372.0 A	11/7/69	14.3	3.2	0.2	0.0	0.6	18.3
372.0 B	11/7/69	8.6	1.2	749.7	3.6	5.7	768.8
371.4 A	17/7/69	11.9	3.2	33.0	0.3	1.0	50.4
371.4 B	17/7/69	1.0	7.6	86.9	0.2	6.3	102.0
370.1 A	18/7/69	14.6	3.8	41.2	0.5	2.6	67.7
370.1 B	18/7/69	23.3	3.4	108.1	2.1	6.4	143.3
370.1 C	18/7/69	18.8	5.6	94.1	5.7	6.1	130.3
368.8 A	21/7/69	2.8	5.6	16.0	1.2	2.6	28.2
368.8 B	21/7/69	13.8	8.9	14.8	3.8	3.7	44.1
366.2 A	17/7/69	3.4	19.1	35.3	6.0	10.2	74.0
364.2 C	21/7/69	6.6	11.8	39.4	0.1	7.4	65.5
362.2 ABC	22/7/69	3.0	7.2	0.3	0.0	7.1	17.6
352.9 ABC	22/7/69	1.9	170.3	0.8	0.0	12.4	185.4
347.3 ABC	23/7/69	5.7	38.7	0.7	0.0	26.4	71.5
322.4 C	11/8/69	0.2	0.1	0.6	0.0	7.9	8.8
195.8 C	2/7/69	0.7	1.9	0.1	0.0	10.8	13.5
192.3 C	2/7/69	0.5	0.5	0.1	0.0	8.2	19.3
191.6 C	2/7/69	1.1	1.9	2.3	0.0	10.1	15.4
190.4 C	2/7/69	0.8	1.6	0.7	0.0	8.8	11.9
189.1 C	2/7/69	0.4	1.1	0.1	0.0	17.2	12.8
187.0 C	1/7/69	3.2	0.8	2.0	0.2	9.7	15.9
182.9 C	1/7/69	3.5	0.9	54.1	0.0	9.3	67.8
161.2 C	30/6/69	14.1	1.2	0.5	0.0	13.2	29.0
136.5 A	30/6/69	7.9	1.2	0.6	0.0	8.5	18.2
136.5 B	30/6/69	5.6	1.0	1.8	0.0	7.2	15.6
128.7 C	24/6/69	3.8	1.2	250.0	2.2	10.4	267.6
128.5 A	24/6/69	13.7	0.3	74.7	0.3	17.1	106.1
128.5 B	24/6/69	13.4	0.0	145.4	2.4	35.2	196.4
128.1 A	24/6/69	3.2	0.8	25.9	0.1	8.1	38.1
128.1 B	24/6/69	7.4	0.2	69.4	0.6	38.8	116.4
127.4 A	25/6/69	10.0	0.8	48.5	0.1	31.5	90.9
127.4 B	25/6/69	14.4	0.6	2.2	0.6	65.0	82.8
126.4 A	25/6/69	13.2	0.6	56.7	0.2	41.2	111.9
126.4 B	25/6/69	11.3	1.0	28.4	0.1	26.0	66.8
125.3 A	25/6/69	10.0	0.8	26.6	0.3	58.6	96.3
125.3 B	25/6/69	6.2	1.1	46.0	0.9	49.0	103.2
124.3 B	25/6/69	21.4	1.1	337.9	0.1	19.8	380.3
123.5 B	25/6/69	11.9	0.9	463.9	0.3	47.7	524.7
122.2 A	25/6/69	10.0	0.7	41.9	0.7	33.0	86.3
122.2 B	25/6/69	9.4	1.8	86.8	1.2	37.2	136.4
120.6 A	26/6/69	6.9	0.8	59.4	1.0	33.3	101.4
120.6 B	26/6/69	6.3	0.8	90.8	0.7	7.1	105.7
118.1 A	26/6/69	6.1	1.4	24.5	1.8	37.9	71.7
118.1 B	26/6/69	4.4	0.7	19.1	1.9	39.0	65.1

TABLE 1.3 (continued)

Station	Date	Algae	Zooplankton	Wood Fibre	Sewage Fungus	Detritus	Total
114.1 B	26/6/69	6.5	1.0	43.5	3.0	22.8	76.8
112.2 B	26/6/69	8.4	1.2	48.0	0.9	16.4	74.9
110.3 A	27/8/69	4.6	0.4	2.2	0.1	14.6	21.9
110.3 B	27/8/69	6.4	0.6	49.0	0.1	15.8	71.9
107.7 AB	27/8/69	4.5	0.8	4.0	0.3	13.1	22.7
103.9 B	27/8/69	6.0	0.9	7.0	0.2	6.9	21.0
101.9 B	27/8/69	4.4	0.6	8.4	0.2	9.2	22.8
100.0 A	27/8/69	4.6	0.6	1.8	0.1	6.0	13.3
100.0 B	27/8/69	3.1	0.5	5.4	0.1	6.5	15.6
95.1 AB	27/8/69	3.4	0.4	1.0	0.1	4.6	9.5
84.8 C	28/8/69	4.5	2.4	0.7	0.0	4.6	12.2
78.8 C	28/8/69	5.9	0.8	0.4	0.0		7.1
68.5 A	28/8/69	0.6	0.6	2.0	0.0	2.5	5.7
68.4 A	28/8/69	6.1	1.3	54.9	0.7	50.7	113.7
68.0 A	28/8/69	3.1	0.7	5.6	8.6	7.4	25.4
66.1 A	28/8/69	10.1	2.4	2.0	0.4	3.6	18.5
66.1 B	28/8/69	10.2	1.3	2.7	0.2	7.2	21.6
63.8 ABC	28/8/69	9.5	2.2	0.5	0.3	3.5	16.0
59.7 C	28/8/69	5.4	1.3	0.9	0.1	5.2	12.9
54.3 ABC	69	8.5	12.0	0.3	0.1	5.3	16.2

TABLE 1.4

PHYSICAL CHARACTERISTICS AT BOTTOM FAUNA STATIONS
AND SUPPLEMENTARY STATIONS
OTTAWA RIVER, 1968 AND 1969

Note:

1. Stations are designated by river miles upstream from the confluence of Des Prairies River with the St. Lawrence River (RM 0.0) as illustrated in the Zone Maps in the Introduction; A - stations near the south shore; B - stations near the north shore; and C - stations near mid-river. Numerical designations are distances in feet of supplementary stations offshore.

2. Legend:

Sa	sand
Si	silt
Cy	clay
R	rock
Sh	shell
Gr	gravel
Ch	wood chip
Fi	wood fibre
Ba	bark
SF	sewage fungus
D	debris
1	chemical odour
2	active decomposition of bottom sediments
3	sludge mats evident on water surface

3. Sediment components are listed in decreasing order of abundance.

TABLE 1.4
PHYSICAL CHARACTERISTICS AT BOTTOM FAUNA STATIONS
AND SUPPLEMENTARY STATIONS
OTTAWA RIVER, 1968 AND 1969

Station	Date	Depth (ft.)	Surface Temperature (°C)	Secchi Disc (ft.)	Sediment Description
385.5 A	30 7 69	42	22.5	7.5	Cy
C	31 7 69	74	21	7.2	Cy
381.7 B	31 7 69	78	21	7.2	Cy
C	31 7 69	130	20	6.5	Cy
372.0 A	17 7 69	7			Sa
B	17 7 69	5			Sa, Fi, SF, 1
371.7 A	10 8 69	9	18		Si, Sa
B	17 7 69	6			Ch, Fi
B	17 7 69	12			Ch, Ba, SF
371.4 A	10 8 69	33	18		Sa, Ch, Ba, SF
B	10 8 69	12	18		Fi, SF
370.7 A	14 7 69	40		6.8	Ch, Fi, SF, 2
C	14 7 69	58		5.0	Ch, Fi, SF, 2, 3
B	14 7 69	25		5.3	Ch, Fi, SF, 2, 3
370.1 A	15 7 69	32			SF, Fi, Ch, R
C	16 7 69	27			Ch, Fi, SF, Si, 3
B	15 7 69	27			Ch, Fi, SF, Si, 2
369.3 A	16 7 69				R, SF, Sa
B	15 7 69	56			Sa, Ch, SF, Si
368.8 A	14 7 69			5.3	SF, R
C	14 7 69	38		5.6	Ch, Fi, SF, Si
C	14 7 69	27		5.9	Ch, Fi, SF, Si
B	14 7 69	10			Ch, Fi, SF, 2, 3
367.4 A	15 7 69	31			Ch, Fi, SF, Si, 2
C	16 7 69	25			Ch, Fi, Sa, Si, 2
C	16 7 69	25			Fi, Si, R
B	15 7 69	25			Fi, Ch, SF, Si, 3
366.2 A	15 7 69	16			Ba, Ch, Fi, SF, Si, 2
C ₁	15 7 69	59			SF
C ₂	15 7 69	93			Si, Ch, Fi, SF
C ₃	15 7 69	112			Si, Ch, Fi, SF, 2
B	15 7 69	59			SF, R
364.2 A	22 7 69	87			Si, Ba, D
C	21 7 69	111			Si, Fi
B	28 7 69	64	20.5	5.8	Si, Fi, Ch
362.2 A	22 7 69	43			Ba, D, Si, 3
C	22 7 69	147	18		Cy, Si
B	22 7 69	121			Cy, Si, Ch
356.1 A	23 7 69	46			Si, Ba, R
C	23 7 69	166	17.7		Cy, Si
B	23 7 69	51			Si
352.9 A	22 7 69	100			Cy, Si, Ba, D
C	22 7 69	125	18		Cy, Si
B	22 7 69	50			Si, Ba, D
350.5 C	23 7 69	138			Cy, Si
B	23 7 69	33			Sa, Si, Ba, Gr

TABLE 1.4 (continued)

Station	Date	Depth (ft.)	Surface Temperature (°C)	Secchi Disc (ft.)	Sediment Description
349.5 A	23 7 69	28			Si, Ba
347.3 B	23 7 69	47			Si, D
345.1 A	23 7 69	39			R
C	25 7 69				R
B	23 7 69	74			Cy, Si, Ba
342.6 B	25 7 69	57	19.5	6.0	Sa, Si, Gr
340.9 A	25 7 69	68	19.0	6.5	Si
C	10 7 69	165			Sa, Si, Ba, Ch
339.5 C	4 8 69	74	19.5	6.0	Sa
338.9 A	4 8 69	28	19	6.0	Sa, Si
B	4 8 69	28	19	6.0	Sa, Si
337.5 A	4 8 69	29	20	7.0	Si, Sa
C	4 8 69	66			Sa, Si
B	4 8 69	12	20	7.0	Si, Sa
333.4 A	7 8 69	23	19	6.0	Si, Sa
C	7 8 69	170+	19	6.0	
B	7 8 69	7	19	6.0	Si, Sa
329.3 A	7 8 69	33	19	6.8	R, Sa, Si
B	7 8 69	14			R, Sa, Si
328.5 C	7 8 69	73			R, Sa
322.4 A	11 8 69	15	18		Si
B	11 8 69	15			Si
314.7 A	14 8 69	10			Si, D
314.2 A	14 8 69	20			Si, D
B	14 8 69	40			Sa, Si
300.7 A	14 8 69	45			Si, D
B	14 8 69	36			Si, D
288.7 A	15 8 69	29			Si, D
B	15 8 69	83			Si, Sa
270.4 C	28 5 69	83	11	6.7	Si
255.8 A	28 5 69	31	12.5	7.7	Si, Sa, Cy
C	28 5 69	92	11.5	4.9	Si, Cy
B	28 5 69	34	12	6.7	Si, Sa, Cy
246.0 C	29 5 69	25		8	Si, Sa
242.5 A	27 5 69	21	10	6	Si, Cy
242.0 A	27 5 69	22	10.5	5.2	Si, Cy
240.5 A	27 5 69	19	9	5.9	Si, 2
A	27 5 69	25	9.5	6.5	Si
240.2 A	26 5 69	20	8		Si, Cy, Sa, Ch
C	26 5 69	57	7		Si, Cy, Ch
B	26 5 69	25	8.4		Si, Cy, Sa
238.9 A	27 5 69	20	10	5.1	Si, Sa, Cy, Ch, Ba
195.8 A	24 7 68	24	22.8	7	Si, Sa, Cy
C	28 7 68	100	20.5		Si, Sa
B	18 7 68	35			Si, Cy, Sa

TABLE 1.4 (continued)

Station	Date	Depth (ft.)	Surface Temperature (°C)	Secchi Disc (ft.)	Sediment Description
192.3 A	18 7 68	15		6.9	Sa, Cy, Si
B	18 7 68	25		7.2	Sa, Cy, Si
191.9 A	29 7 68	50	21	5.3	Sa, Si
B	15 7 68	20		7.7	Si, Sa
191.6 A	15 7 68	30	24.5	6.7	Si, Sa
B	15 7 68	24		6.0	Si, Sa
190.4 B	15 7 68	25	22.5	5.0	Si, Sa
189.1 A	25 7 68	60	23.8	6.2	Si, Sa
B	25 7 68	50	22.9	5.3	Si, Sa
182.9 C	21 5 69	50	9		Si, Cy, D
175.7 A	21 5 69	45	9	2.8	Si, Cy, D
B	21 5 69	18	9	3.0	Si, Cy
172.5 C	21 5 69	85	9	2.9	Si, Cy
168.0 A	19 5 69	13			Si, Cy, Ch
C	20 5 69	33	10.0	3.0	Si, Cy, Ch
B	20 5 69	15	10.0	6.0	Si, Cy, Ch
156.4 C	15 5 69	20		5.5	Si, Sa
149.9 A	15 5 69	20		5.5	Si, Cy
C	15 5 69	90	9.0	6.0	Si
B	15 5 69	18		5.5	Si, Cy, Gr
149.3 A	13 5 69	42			Si, Cy
C	14 5 69	80		4.2	Si, Cy
B	14 5 69	15			Si, Cy
136.5 C	13 5 69	25			Si, Cy
129.1 B	8 7 68	8	18	5.8	Ch, Fi, Si, 2
128.7 A	8 7 68	55	18.5	6.3	R
C	8 7 68	20	19	5.4	Ch, Fi, Ba, 2
B	8 7 68	26	19	5.2	Ch, Fi
128.5 A 100	24 6 69				R
300	24 6 69				R
600	24 6 69				R
B 400	24 6 69				D, Ch, Fi, 2
500	24 6 69				Fi, Ba, D, 2
800	24 6 69				Ch, Fi, Ba
128.3 A	8 8 68	55	19.0	5.8	Sa
C	12 8 68	40	19.6	5.3	Fi, Ch
B	12 8 68	11		3.8	Ch, Fi, Si, R, 2
128.1 A 100	24 6 69				R, Ba
300	24 6 69				R, Ba
600	24 6 69				Ch, Fi, Si
B 100	24 6 69				Ch, Fi, D, 2
500	24 6 69				Fi, Ba, D, 2
800	24 6 69				Ch, Fi, Ba
127.8 A	9 7 68	23	19.3	5.5	Sa, Gr, R, Si, D
127.5 A 300	25 6 69				Cy, Si
800	25 6 69				Cy, Si, Ch

TABLE 1.4 (continued)

Station	Date	Depth (ft.)	Surface Temperature (°C)	Secchi Disc (ft.)	Sediment Description
127.4 A	9 7 68	48	20	4.3	R, Ba
B	9 7 68	14	19.9	4.2	Ba, Ch
500	24 6 69				Sa, Ba
126.4 A	9 7 68	28	20	6.0	Si, D
100	25 6 69				Si, Ch
300	25 6 69				Ch
500	25 6 69				Sa, Ba, Ch
800	25 6 69				R
B	9 7 68	7	19.7		Sa, Si, Ch, Fi
100	25 6 69				Sa, Si
300	26 6 69				Sa, Si
500	26 6 69				Sa
700	25 6 69				Sa
125.3 A	3 7 68	10	17.8	5.1	Sa, Ch
100*	25 6 69				Sa
400*	25 6 69				Sa
800*	25 6 69				Sa
B	2 7 68	17	18	5.0	Sa, Ch
	25 6 69				Sa, Ch
124.3 A	5 7 68	10	18	4.0	Si, Sa, Cy
B	3 7 68	14	18.3	2.0	Fi, Ch, Sa, 1
	25 6 69				Fi, Ch, Si, Sa, 1,2
123.5 B	2 7 68	14	18.5	3.0	Ch, Fi, Sa
50	25 6 69				Ch, Fi, Sa, 2
200	25 6 69				Ch, Fi, Ba, Sa, 2
122.2 A	4 7 68	12	17.9	5.2	Si, Cy, D, Ch
200	25 6 69				Gr
800	25 6 69				Sa, Si, Ch
1100	25 6 69				Sa
1400	25 6 69				Sa, Ch
B	3 7 68	13	18.5	4.0	Sa, Ba, Ch
100	25 6 69				SF, Fi, D, 2
300	25 6 69				SF, Ch, Fi, R
600	25 6 69				Sa
1000	25 6 69				Sa
122.0 A	3 7 68	11	19.5	3.4	Sa, Ch, Ba
120.6 A	5 7 68	12	15	4.5	Cy
100	26 6 69				Cy, Si
500	26 6 69				Sa, Ba
900	26 6 69				Sa
B	9 7 68	8	18.4	4.7	Sa, Si, Ch
50	26 6 69				Si, Sa, Fi
200	26 6 69				Sa, SF, Ch
400	26 6 69				Sa, Ch
800	26 6 69				Sa, Ch, Fi
119.6 C	27 8 68	40			Sa, Cy

* distance south of Kettle Island

TABLE 1.4 (continued)

Station	Date	Depth (ft.)	Surface Temperature (°C)	Secchi Disc (ft.)	Sediment Description
119.0 A	100	26 6 69			Cy
	400	26 6 69			Cy
	900	26 6 69			Sa
119.0 B	100	26 6 69			Cy, Si, Fi, 2
	300	26 6 69			Si, Fi, Ch, 2
	600	26 6 69			Ch, Fi, Sa
	900	26 6 69			Sa, Fi, Ch
	1300	26 6 69			Sa, Fi
118.1 A	4 7 68	12	17.9	4.8	Sa, Si, Ch, Ba
	100	26 6 69			Si, Ch, Ba
	600	26 6 69			Sa
B	9 7 68	10	18.6	2.9	Si, Sa, Ch, Ba
	100	26 6 69			Fi, Ch, Si, 2
	400	26 6 69			Cy
	900	26 6 69			Sa, Fi
114.1 A	4 6 68	25	16.0	5.6	Ch, Si
B	31 5 68	17	14	2.5	Sa, Si, D
	100	26 6 69			Sa, Cy, Ch, Fi
	300	26 6 69			Sa, Ch, SF, Ba
	600	26 6 69			Sa
	800	26 6 69			Sa
113.1 A	11 6 68	37	16	3.5	Sa, Si, D
B	3 6 68	17	15	5.0	Ch, Si, Sa, Fi, 2
112.2 B	11 6 68	30	16	4.5-5	Fi, Ch, Si
	50	26 6 69			Ch, Fi, 2
	150	26 6 69			Fi, Ch, Si
	300	26 6 69			Fi, Ch, Si
111.3 A	31 5 68	25	13.5	4.2	Si, Sa, D
B	11 6 68	31	16	4.5	Sa, Ch, Fi, Si
110.3 A	300	27 8 69	7		Si, Sa, Cy, Ch, Ba
	600	27 8 69	17		Si, Sa, Cy, Ba, Ch
	1000	27 8 69	24		Sa, Si, Ch, Ba
B	31 5 68	17	14	3.8	Si, Sa, D
	250	27 8 69	19		Sa, Si, Cy
	700	27 8 69	35		Sa, Si, Cy
107.7 A	17 6 68	31	18	5.3	Si, Sa, D
	300	27 8 68	9		Si, Sa, Ba
	900	27 8 68	23		Si, Sa, Ba
107.7 B	17 6 68	15	18	5.5	Si, Sa, D
	600	27 8 69	19		Sa, Si, Ch
	1000	27 8 69	29		Sa, Ch
	1300	27 8 69	26		Sa, Ba
105.5 C	28 8 69	68			Sa, Fi
103.9 A	17 6 68	10	21	5.1	Si, D
B	17 6 68	9	18	4.3	Sa, Si, D
	200	27 8 69	9		Sa, Ch
	900	27 8 69	29		Sa, Ch
	1400	27 8 69	27		Si, Sa

TABLE 1.4 (continued)

Station	Date	Depth (ft.)	Surface Temperature (°C)	Secchi Disc (ft.)	Sediment Description
101.9 B	28 8 68	40	18.9	4.0	Ch, Fi
300	27 8 69	16			Sa, Si, Fi, Ch
800	27 8 69	42			Sa, Si
1400	27 8 69	41			Sa, Si
101.1 B	19 6 68	12	18.7	4.3	Si, Sa, D, Fi, Ch
101.1 C	28 8 68	45			Sa, Ch, Ba, Fi
100.0 A	19 6 68	35	18.2	5.8	Si, D
150	27 8 69	10			Cy, Sa, Si
800	27 8 69	25			Si, Sa, Ch, Fi
B	19 6 68	31	18.2	5.9	Si, Sa, Ch
500	27 8 69	28			Si, Sa, Ch, Fi
1400	27 8 69	16			Si, Sa, Ch, Fi
2200	27 8 69	12			Si, Sa, Ch
97.8 A	20 6 68	30	17	4.7	Si, Gr, Cy, D
B	20 6 68	13	17	3.2	Si, Fi
96.6 C	28 8 68	65	18.9	6.3	Cy
95.1 A	24 6 68	20	17.3	5.8	Cy, Si, D
400	27 8 68	18			Si, Cy
700	27 8 68	37			Sa, Si
1400	27 8 68	25			Sa, Si, Ch
B	20 6 68	11	17	4.2	Si, Sa, Ch
200	27 8 69	7			Sa, Si, Ch
500	27 8 69	22			Cy, Si, Sa, Ch
93.2 C	28 8 68	130	18.9	6.0	Fi, Ch, Si, 2
90.7 A	22 8 68	19	19.0	6.6	Ch, Fi
C	22 8 68	87	19.1	6.3	Si, Fi
B	22 8 68	14	19.0	6.0	Si, Cy, Ch, Fi
84.8 C	22 8 68	105	18.9	6.2	Ch, Fi, Si, 2
78.8 A	21 8 68	7	19.7	2.8	Si, Ch, Fi
C	21 8 68	100	19.5	6.0	Si
B	21 8 68	10	19.8	5.0	Si, Fi
71.8 C	18 8 68	57	20.5	5.9	Si, D, Ch
70.2 A	21 5 68	15	13	5.5	Si, Gr
70.0 B	20 5 68	26	12	-	Si, Sa
68.5 A	18 5 68	17	12	5.0	Ba, Si
68.4 A	23 5 68	9	14	4.7	Ba, Ch
68.2 A	18 5 68	17	12	5.0	Si, Ba, Ch, Sa
68.1 A	27 5 68	18	14.5	5.1	Si, Ba, Ch, Sa
68.1 B	27 5 68	15	14	5.5	R
68.0 A	17 5 68	8	12	-	R, SF
67.9 A	27 5 68	8	14	4.0	R
67.7 A	21 5 68	7	13	4.5	Si, Sa, D
67.6 A	20 5 68	13	12	-	Si, Sa, D
67.5 A	27 5 68	11	15	3.5	Si, Ch
400	28 8 69	12			Si, Sa, Ch, Fi, Ba
900	28 8 69	9			Ch, Ba, Fi, Si, Sa
1200	28 8 69	16			Ba, Ch, R
1800	28 8 69	18			Fi, Si, Sa, 2, 3

TABLE 1.4 (continued)

Station	Date	Depth (ft.)	Surface Temperature (°C)	Secchi Disc (ft.)	Sediment Description
67.5 A	2000	28 8 69			R
66.1 A	28 5 68	11	14.5	3.0	Si, D
	100	28 8 69			R
	500	28 8 69			R
	700	28 8 69			R
	1000	28 8 69	39		Ch, Ba, Fi, R
	1400	28 8 69	38		R
B	28 5 68	9	14	3.8	Si, Gr
63.8 A	30 5 68	15	14.5	3.5	D, Si
	150	28 8 69	24		Si
	1200	28 8 69	54		R
B	30 5 68	25	14.6	6.0	D, Si
	1700	28 8 69	18		Si, Fi
62.7 C	20 8 68	200			Si, R
59.7 A	28 5 68	16	15	3.5	Si
B	28 5 68	32	15	4.2	Si
	800	28 8 69			Si, Ch, Fi
	1300	28 8 69			Si, Fi
58.9 A	19 8 68	7	19.3	5.0	Si
C	19 8 68	95	19.0	5.8	Si, Sh
B	19 8 68	31	19.4	4.0	Si
57.0 A	28 5 68	22	15	4.2	Si, D
54.3 A	18 8 69	20			Si, Sa, Ch
C	18 8 69	38	21	5.5	Si, Sa, Gr
B	18 8 69	34			Si, Sa, Ch
51.3 A	20 8 69	14			Cy
C	20 8 69	55			Cy
B	22 8 69	24			Ch, Cy, Sa
47.3 A	23 8 69	19			Cy, Si, Ch
B	23 8 69	14			Sa, Si, Ch
41.2 A	23 8 69	24			Si, Cy, Fi
C	23 8 69	37			Si, Cy, Ch, Fi
B	23 8 69	14			Si, Cy, Fi
39.0 A	22 8 69	10			Cy
C	22 8 69	54			Cy
B	21 8 69	10			Cy

TABLE 1.5

SUPPLEMENTARY DATA, ARTIFICIAL SUBSTRATE
SAMPLING, OTTAWA RIVER, 1968 AND 1969

Note:

Stations are designated by river miles measured upstream from the confluence of the Des Prairies River with the St. Lawrence River (RM 0.0) as illustrated on the Zone Maps in the Introduction;

- A stations near the south shore,
- B stations near the north shore,
- C stations near mid-river.

Legend:

- | | | |
|----|---|---------------|
| Sa | - | sand |
| Si | - | silt |
| Cy | - | clay |
| R | - | rock |
| Gr | - | gravel |
| Ch | - | wood chip |
| Fi | - | wood fibre |
| Ba | - | bark |
| SF | - | sewage fungus |
| D | - | debris |

TABLE 1.5

SUPPLEMENTARY DATA, ARTIFICIAL SUBSTRATE
SAMPLING, OTTAWA RIVER, 1968 AND 1969

Station	Installed	Retrieved	Depth of Station (ft.)	Depth of Sampler (ft.)	Surface Current (f.p.s.)	Bottom Description
371.7A	16/7/69	3/9/69	3	3	0.5	R, Sa
371.4A	16/7/69	3/9/69	5	4		Sa
371.4B	16/7/69	3/9/69	1.5	1.5		R, Fi, SF
370.6C	16/7/69	3/9/69	6	5	0.5	R, SF
368.4A	16/7/69	4/9/69	4	3.5	<0.3	
367.4B	16/7/69	4/9/69	18	12		
362.2B	22/7/69	6/9/69	5	2		R
356.1B	23/7/69	6/9/69	1	1	0	R
352.9A	22/7/69	6/9/69	3	3		R
352.9B	22/7/69	6/9/69	3	3		R
347.3A	23/7/69	6/9/69	4	4	0	R
347.3B	23/7/69	6/9/69	4	4		R
344.3C	25/7/69	6/9/69	3	3		R, Sa
342.0A	25/7/69	6/9/69	3	3		R
342.0B	25/7/69	6/9/69	3.5	3.5		R
342.0C	25/7/69	6/9/69	75	73		Sa, Si
333.9A	11/8/69	8/9/69	6	6	<0.5	R
325.1B	11/8/69	8/9/69	12	35	1	R
195.8B	8/8/68	17/9/68	49	47	0.5	R
192.3B	8/8/68	17/9/68	43	41	1	R
191.9Ba	9/8/68	17/9/68	56	56		Sa
191.9Bb	10/8/68	17/9/68	42	42		R
191.6A	7/8/68	18/9/68	77	77	0	Sa, Si
190.4B	6/8/68	18/9/68	43	41		R
188.5A	69	16/9/69		6		
188.5B	69	16/9/69		6		
129.3A	29/7/68	2/9/68	5	5	1.5-2	R
129.3C	30/7/68	2/9/68	1	1	1.5-2	R
129.2A	29/7/68	2/9/68	1.5	1.5		R
129.2D	29/7/68	2/9/68	4	4	3	R
129.1A ₁	27/7/68	1/9/68	2.5	2.5	2	R, Gr, Sa
129.1A ₂	27/7/68	1/9/68	1.5	1.5	2	R, Gr, Sa
129.1B	27/7/68	1/9/68	1.5	1.5	1	R
128.7A	22/7/68	30/8/68	4	4		R, Sa
128.3A	22/7/68	30/8/68	4	4		R, Sa
127.8A	30/7/68	30/8/68	2	2	1.5	R, Sa, Si
127.4B	22/7/68	30/8/68	4	4		R
126.4A	22/7/68	30/8/68	28	26	1.5	Si, D
126.4B	29/7/68	30/8/68	3	3	<1	R, Si
123.5B	5/7/68	14/8/68	13	13	1.4	Ch, Fi, Sa
122.2A	5/7/68	12/8/68	12	12	1.5	Cy, Si, D, Ch
122.2B	5/7/68	12/8/68	15	13	2	Sa, Ba, Fi
120.6A	7/7/68	13/8/68	29	29	2	Sa
120.6B	7/7/68	13/8/68	10	8	1.5	Sa, Fi
118.1A	5/7/68	13/8/68	13	13	1.3	Sa
113.1A	4/6/68	16/7/68	24	2		Si, Sa, D
113.1B	4/6/68	16/7/68	31	2	1.5	Sa, Ch, Fi, Si

TABLE 1.5 (continued)

Station	Date Installed	Date Retrieved	Depth of Station (ft.)	Depth of Sampler (ft.)	Surface Current (f.p.s.)	Bottom Description
112.2A	4/6/68	16/7/68	40	2	2	
112.2B	4/6/68	16/7/68	30	2	0.5	Fi, Ch, Si
111.3A	4/6/68	19/7/68	24	2		Si, Sa, D
111.3B	4/6/68	19/7/68	30	2	1.5	Sa, Ch, Fi, S
110.3B	4/6/68	24/7/68	17	2		Si, Sa, D
107.7B	19/6/68	25/7/68	25	23	1	Sa, Si, D
106.7C	7/6/68	25/7/68	32	2		
103.9A	17/6/68	27/7/68	25	23	1.5	Si, D
103.9B	7/6/68	26/7/68	30	28	1	Si, Sa
101.9A		27/7/68	31	31		
100.2A	20/6/68	27/7/68	2	2	0.1	Si, D
100.0C	14/6/68	27/7/68	20	20	1	Si, Sa
97.8C	14/6/68	28/7/68	18	2	1	
97.8C	14/6/68	28/7/68	18	18	1	
69.9A	16/5/68	18/6/68	10	2	2	R
69.9A	16/5/68	18/6/68	10	10	2	R
70.0B	16/5/68	13/6/68	28	2	1	Si
70.0B	16/5/68	13/6/68	28	26	1	Si
68.5A	16/5/68	13/6/68	12	2	1	R
68.5A	16/5/68	18/6/68	12	10	1	R
68.4A	16/5/68	13/6/68	3	2	0	Ba
68.1B	19/5/68	13/6/68	10	2	1.7	R
68.0A	17/5/68	20/6/68	5	2	3	R
67.7A	19/5/68	18/6/68	13	13	1	R
66.1B	19/5/68	20/6/68	27	25	2	R
66.1B	19/5/68	13/6/68	27	27	2	R
63.4A	19/5/68	18/6/68	5	5	0	R
63.8B	19/5/68	23/6/68	25	2	0	R
63.8B	19/5/68	23/6/68	25	2	0	R
63.8B	19/5/68	18/6/68	2	2	0	R
60.2A	19/5/68	18/6/68	4	2	0	R

TABLE 1.6

CONCENTRATIONS (mg/l) OF MERCURY IN BOTTOM SEDIMENTS
OTTAWA RIVER, 1968 AND 1969

Note:

Stations are designated by river miles measured upstream from the confluence of the Des Prairies River with the St. Lawrence River (RM 0.0) as illustrated on the Zone Maps in the Introduction;

- A stations near the south shore,
- B stations near the north shore,
- C stations near mid-river.

TABLE 1.6

CONCENTRATIONS (mg/l) OF MERCURY IN BOTTOM SEDIMENTS,
OTTAWA RIVER, 1968 AND 1969

Station	Date	Hg	Station	Date	Hg
385.8 A	30 7 69	0.02	124.3 B	3 7 68	2.0
372.0 A	17 7 69	0.07	123.5 B	2 7 68	0.63
371.4 A	10 8 69	0.03	B	25 6 69	0.80
B	10 8 69	0.28	123.4 B	25 6 69	0.33
366.2 C ₃	15 6 69	0.03	122.2 A	4 7 68	0.15
362.2 C	22 7 69	0.12	B	3 7 68	0.03
352.9 C	22 7 69	0.10	B	25 6 69	0.34
345.1 A	23 7 69	0.10	120.6 A	26 6 69	0.15
340.9 C	10 7 69	0.06	B	9 7 68	0.14
339.5 C	4 8 69	0.02	118.1 A	4 7 68	0.22
322.4 A,B	11 8 69	0.10	B	9 7 68	0.36
288.7 A	15 8 69	0.08	112.2 B	26 6 69	0.21
240.2 C	9 8 68	0.19	111.3 A	31 5 68	0.33
195.8 A	24 7 68	0.08	107.7 A	17 6 68	0.12
C	28 7 68	0.05	B	17 6 68	0.08
191.9 A	29 7 68	0.05	103.9 B	17 6 68	0.17
191.6 A	15 7 68	0.10	100.0 A	19 6 68	0.40
B	15 7 68	0.08	B	19 6 68	0.27
189.1 A	25 7 68	0.07	95.1 B	20 6 68	0.28
B	25 7 68	0.08	84.8 C	22 8 68	0.26
182.9 C	21 5 69	0.07	78.8 A	21 8 68	0.45
143.3 A	26 8 68	0.20	C	20 8 68	0.83
C	26 8 68	0.09	B	21 8 68	0.71
B	26 8 68	0.17	70.0 B	20 5 68	0.29
129.1 B	8 7 68	1.1	67.5 B	27 5 68	0.25
128.7 B	8 7 68	0.17	66.1 A	28 5 68	0.48
128.5 B	24 6 69	0.16	B	28 5 68	0.54
128.3 A	8 7 68	0.54	62.7 C	20 8 68	0.85
B	12 7 68	0.70	58.9 A	19 8 68	0.46
128.1 A	24 6 69	0.39	C	19 8 68	0.14
B	24 6 69	0.52	Brewery Ck.	24 6 69	0.83
126.4 A	9 7 68	0.36	Lievre R.	12 6 68	0.07
A	25 6 69	0.26			
B	9 7 68	0.09			
B	25 6 69	0.05			
125.3 B	2 7 68	0.04			
B	14 8 68	0.04			

CHAPTER 2

BACTERIOLOGY

2.1 SCOPE OF THE STUDY

Bacteriological surveys were included in the water quality evaluations carried out on the Ottawa River during 1968 and 1969. These studies were undertaken to define the bacteriological water quality within the river, and to determine some relationships of sulfur bacterial flora to pulp and paper waste effluents within the Ottawa River.

The bacteriological water quality was based on total coliform (TC), fecal coliform (FC) and fecal streptococcus (FS) determinations which were used as "indicators" of fecal pollution. These "indicators" are the normal flora of the large intestine and are present in large numbers in the feces of man and animals. When water is polluted with fecal material, there is a potential danger that pathogens or disease causing micro-organisms may also be present.

The coliform group is defined, according to Standard Methods 13th Edition, as "all of the aerobic and facultative anaerobic, gram-negative, non-sporeforming rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°C, and or "all organisms which produce a colony with a golden green metallic sheen within 24-hours of incubation" using the MF technique. This definition includes, in addition to the intestinal forms of the *Escherichia coli* group, closely related bacteria of the genera *Citrobacter* and *Enterobacter*. The *Enterobacter* - *Citrobacter* groups are common in soil, but are also recovered in feces in small numbers and their presence in water may indicate soil runoff or, more important, less recent fecal pollution since these organisms tend to survive longer in water than do members of the *Escherichia* group, and even to multiply when suitable environmental conditions exist. A more specific test of coliforms of intestinal origin is the fecal coliform test, with incubation of the organisms at 44.5°C. Though by no means completely selective for *Escherichia coli*, this test has proved useful as an indicator of recent fecal pollution.

Fecal streptococci (or enterococci) are also valuable indicators of recent fecal pollution. These organisms are large, ovoid gram-positive bacteria, occurring in chains. They are normal inhabitants of the large intestine of man and animals, and they generally do not multiply outside the body. In waters polluted with

fecal material, fecal streptococci are usually found along with coliform bacteria, but in smaller numbers, although in some waters they may be found alone. Their presence, along with coliforms, indicates that at least a portion of the coliforms in the sample are of fecal origin.

2.2 METHODS

The data presented in this chapter were compiled from samples taken by the OWRC monitoring program, the OWRC sampling program associated with the bacteriology mobile laboratory, and samples taken and analyzed by the Ontario Department of Health (1).

The OWRC samples were taken in sterile 6 oz. bottles from about one meter below the surface. These samples were stored on ice until delivery to either the mobile laboratory or the Toronto laboratory. The mobile laboratory was used during most of the Ottawa River survey to provide on the site analyses of samples with minimum delay between the time of sampling and the time of analyses.

Samples were analyzed for total coliforms (TC), fecal coliforms (FC), fecal streptococcus (FS) and total plate count organisms (PC) using the membrane filtration technique (MF) as outlined in Standard Methods (A.P.H.A., 1971) except the MacConkey membrane broth (Oxoid) was used for fecal coliform determinations.

The Ontario Department of Health used the most probable number (M.P.N.) technique for their determinations.

2.3 RESULTS

A detailed listing of the bacteriological results for samples collected in the Ottawa River are presented in Table 2.1. These results are also presented graphically in Figure 2.3.

(1) *Bacteriological results courtesy of the Ottawa-Carleton East View Health Unit, Dr. L.H. Douglas, for bathing areas on the Ottawa and Rideau rivers from 1954 to 1968.*

2.4 SOME ECOLOGICAL ASPECTS OF SULFATE-REDUCING AND
SULFUR-OXIDIZING BACTERIA IN AREAS OF THE OTTAWA
RIVER AFFECTED BY PULP AND PAPER MILL WASTES

An unpublished report by the above title was prepared by Mr. Frank Thompson in 1970. Mr. Thompson summarizes his report as follows:

"A bacteriological survey of the Ottawa River was conducted during the summer of 1969 and concentrated on sections of the river where water quality was impaired by wastes from pulp and paper industries. Counts of sulfate-reducing and sulfur-oxidizing bacteria in sediment and surface water were significantly greater in zones below than in areas above the outfalls from paper mills. These parameters appeared to be relatively more sensitive than coliform counts or total plate counts in indicating reaches of the river, in proximity to the mill outfalls where water was most heavily polluted by these industrial wastes. Sulfur substrates which are normally lacking in natural, unpolluted river water, but are found in significantly high concentrations in waste sulfite and kraft liquors apparently contributed to the increased populations of sulfur bacteria found in zones below mill outfalls". (Thompson, 1970).

REFERENCES

- Deaner, D.G. and K.D. Kerri, 'Regrowth of Fecal Coliforms', J.A.W.W.A., 61, 1969, 465-468.
- Dutka, B.J., J. Popplow and J. Yurack, 'The Isolation of *Salmonellae* from the Bay of Quinte and the St. Lawrence River', Department of National Health and Welfare, Division of Public Health Engineering, 1967.
- Gallagher, T.P. and D.F. Spino, 'The Significance of Numbers of Coliform Bacteria as an Indicator of Enteric Pathogens', Water Resources, 2, 1968, 169-175.
- Geldreich, E.E., 'Fecal Coliform Concepts in Stream Pollution', Water Sewage Works, 114, 1967, R98-R110.
- Geldreich, E.E., et al, 'The Bacteriological Aspects of Storm Water Pollution', J.W.P.C.F., 40, 1968, 1861-1872.
- Johnson, G.M. and H.J. Edde, 'The Significance of Coliform Bacteria in Pulp and Paper Mill Waste Waters', Proc. 16th South Water Resources Pollution Control Conf. (Duke), 1967, pp. 26-32.
- Kabler, P.W., 'Microbial Considerations in Drinking Water', J.A.W.W.A., 60, 1968, 1173-1180.
- Kittrell, F.W. and S.A. Furfari, 'Observations of Coliform Bacteria in Streams', J.W.P.C.F., 35, 1963, 1361-1385.
- Ontario Water Resources Commission, 'Guidelines and Criteria for Water Quality Management in Ontario,' 1970.
- Ontario Water Resources Commission, M. Jones, 'The Georgian Bay Survey Bacteriology Report', 1970.
- Ontario Water Resources Commission - Quebec Water Board, 'Ottawa River Basin - Water Quality and Its Control', Vol. 1, 1971.
- Rao, N.V. et al, 'Coliforms as Indicators of Fecal Pollution', Environ. Health, 10, 1968, 21-28.
- Taylor, C.B., 'The Ecology and Significance of the Different Types of Coliform Bacteria found in Water', J. Hygiene, 42, 1942, 23-44.

Thompson, F., 'Some Ecological Aspects of Sulphate - Reducing and Sulphur Oxidizing Bacteria in Areas of the Ottawa River Affected by Pulp and Paper Mill Wastes', Bacteriology Branch, Division of Laboratories, Ontario Water Resources Commission, March 1970 (unpublished).

VanDonsel, S.J., E.E. Geldreich and N.A. Clarke, 'Seasonal Variation in Survival of Indicator Bacteria in Soil and their Contribution to Storm-Water Pollution', Appl. Micro, 15, 1967, 1362-1370.

TABLE 2.1

BACTERIOLOGICAL RESULTS

OTTAWA RIVER

Note:

The data generated have been grouped according to river mileage (see Zone Maps in Introduction) and summarized by geometric means (the antilogarithm of the average of the logarithms). The number of results that constitute the geometric mean has been placed in brackets () after the mean.

Where applicable, a letter was inserted in the tables (before the town or area) to designate where the sample was taken; (a) is from the Ontario shore, (b) is from mid-river, and (c) is from the Quebec shore.

The tributary data have the mileage of the point of entry into the Ottawa River and below that, the distance in miles up the tributary where the sample was taken. This mileage is preceded by an "R".

TABLE 2.1

BACTERIOLOGICAL RESULTS

Ottawa River

Town or Area	Mileage	Year	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml	Fecal Streptococcus per 100 ml	Plate Count per 100 ml
Gordon Creek	374	1968	116 (10)	16 (6)	10 (5)	-
	R0.0	1969	3,516 (3)	116 (4)	100 (3)	-
(b) Temiscaming	372.4	1968	147 (15)	13 (10)	39 (7)	3.0×10^4 (3)
		1969	49 (9)	7 (8)	33 (8)	2.0×10^4 (2)
Big Jocko River	360	1968	319 (5)	43 (3)	149 (2)	-
	R0.0	1969	709 (2)	259 (2)	69 (2)	-
(b) Otto Holden Dam	340.9	1968	59 (20)	17 (13)	13 (9)	1.0×10^5 (4)
		1969	72 (9)	2 (8)	14 (8)	-
(b) R.R. Bridge at Mattawa	336.9	1968	372 (19)	14 (13)	75 (15)	7.3×10^4 (2)
		1969	43 (11)	2 (11)	3 (11)	4.5×10^4 (2)
Mattawa River	336.7	1968	361 (4)	24 (3)	160 (3)	
	R0.1	1969	61 (4)	14 (4)	5 (4)	6.7×10^4 (2)
(a) Deux Riviere between Ontario Island and First Island	314.2	1968	126 (4)	31 (3)	43 (3)	-
		1969	68 (2)	68 (2)	-	-
(b) Deux Riviere Main Channel	314.2	1968	101 (10)	4 (6)	32 (7)	-
		1969	69 (8)	3 (6)	2 (6)	-
(b) Deux Riviere between First and Second Island	314.2	1968	100 (5)	9 (3)	20 (3)	-
		1969	15 (2)	1 (2)	2	-

TABLE 2.1 (continued)

Town or Area	Mileage	Year	Total Coliforms per 100 ml	Total Coliforms per 100 ml	Fecal Streptococcus per 100 ml	Plate Count per 100 ml
Deux Riviere Creek	314.2 R0.0	1968 1969	62 (4) 17 (2)	9 (3) 2 (2)	25 (3) 11 (2)	- -
(b)Des Joachims	282.0	1968 1969	10 (14) 3 (7)	3 (8) 2 (7)	79 (10) 2 (7)	- -
Petawawa River	252.0 R1.8	1968 1969	667 (4) 56 (3)	27 (2) 3 (3)	20 (2) 8 (3)	- -
(a)Petawawa Point	249.0	1969	268 (7)	29 (7)	5 (7)	4.3×10^3 (7)
(b)Le Blank Island	243.5	1969	182 (5)	6 (5)	2 (5)	2.7×10^3 (5)
Muskrat River	241.9 R0.2	1968 1969	3,860 (5) 1,040 (3)	1,100 (4) 153 (2)	703 (4) 106 (2)	7.3×10^4 (1) -
(c)Pembroke between Allumette Island and Morriston Island	237.9	1968 1969	1,630 (7) 543 (2)	523 (6) 109 (2)	57 (6) 2 (2)	- -
(b)Pembroke between Cotnam Island and Morriston Island	237.9	1968	291 (9)	147 (7)	37 (8)	-
(a)Pembroke between Ontario Mainland and Cotnam Island	237.9	1968 1969	1,750 (5) 88 (2)	350 (4) 4 (2)	54 (4) 2 (2)	- -

TABLE 2.1 (continued)

Town of Area	Mileage	Year	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml	Fecal Streptococcus per 100 ml	Plate Count per 100 ml
(c)Waltham Station at the bridge to Allumette Island	223.2	1968 1969	70 (50) -	6 (2) 2 (2)	10 (4) -	2.1×10^4 (1) -
Coulong River	210.9 R3.6	1968 1969	124 (5) 36 (2)	14 (2) 4 (2)	32 (2) 16 (2)	3.4×10^4 (2) -
(a)Bryson	198.9	1968 1969	102 (5) 107 (3)	11 (3) 37 (2)	69 (4) 17 (2)	1.9×10^4 (1) -
(a)ChenauX at Main Dam	188.6	1968 1969	15 (15) 42 (5)	6 (4) 7 (4)	15 (4) 9 (4)	2.0×10^4 (2) -
(c)ChenauX at Centre of Spillway East of Limerick Island	188.6	1968 1969	120 (5) 41 (2)	5 (2) 4 (2)	45 (2) 14 (2)	1.8×10^4 (1) -
(b)ChenauX at Centre of Spillway West of Limerick Island	188.6	1968 1969	237 (4) 57 (2)	12 (3) 8 (2)	8 (3) 9 (2)	1.5×10^4 (1) -
Creek to Dead Bay	190.3 R0.6	1968	1,000 (5)	318 (4)	1,000 (4)	8.9×10^4 (1)
Bonnechere River	181.0 R0.5	1968 1969	2,100 (5) 270 (3)	1,190 (3) 83 (2)	84 (2) 42 (2)	1.2×10^4 (1) -
Douchart Creek	170.3 R0.4	1968 1969	2,521 (4) 243 (3)	1,864 (4) 364 (2)	344 (4) 123 (2)	- -
Madawaska River	169.4 R0.7	1968 1969	168 (5) 25 (3)	77 (5) 18 (2)	18 (3) 5 (2)	1.8×10^4 (1) -

TABLE 2.1 (continued)

Town or Area	Mileage	Year	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml	Fecal Streptococcus per 100 ml	Plate Count per 100 ml
Mississippi River	169.2 R2.3	1968 1969	214 (4) 14 (3)	27 (4) 32 (2)	151 (3) 1 (2)	4.3×10^4 (1) 1.8×10^4 (1)
(a)Fitzroy * Provincial Park	167.0	1968	276 (14)	15 (14)	-	-
(b)Galletta-Chats Falls	165.0	1968 1969	245 (4) 9 (2)	82 (4) 36 (2)	261 (4) 9 (2)	7.3×10^4 (1) 7.9×10^4 (1)
(b)Chats Falls	163.6	1968 1969	344 (19) 11 (9)	23 (15) 2 (8)	8 (13) 2 (9)	7.7×10^4 (4) 1.1×10^4 (4)
(a)Quyon Ontario side	160.6	1968 1969	403 (4) 13 (2)	18 (3) 29 (2)	206 (4) 6 (2)	- -
(b)Quyon Mid-River	160.6	1968 1969	81 (5) 24 (2)	20 (4) 35 (2)	- 16 (2)	- -
(c)Quyon Ferry Quebec Side	160.6	1968 1969	97 (5) 11 (2)	72 (4) 47 (2)	84 (3) 1 (2)	- -
Quyon River	160.4 R0.7	1968 1969	514 (4) 76 (3)	359 (4) 11 (2)	334 (4) 2 (2)	1.9×10^5 (1) 5.2×10^5 (1)
(a)McLarens * Landing	157.6	1968	113 (7)	6 (7)	-	-
(a)Camp Woolsey *	156.5	1968	152 (12)	18 (12)	-	-
(a)Buckhans Bay *	154.9	1968 1969	426 (11) 214 (2)	69 (11) 87 (2)	- -	- -

TABLE 2.1 (continued)

Town or Area	Mileage	Year	Total Coliform per 100 ml	Fecal Coliform per 100 ml	Fecal Streptococcus per 100 ml	Plate Count per 100 ml
(a)Constance Bay*	152.8	1968	70 (10)	23 (10)	-	-
	to 151.3	1969	131 (5)	63 (5)	-	-
(a)Baskin Beach*	151.0	1968	417 (5)	10 (5)	-	-
		1969	138 (5)	67 (5)	-	-
(a)Camp YMCA*	142.1	1968	68 (5)	7 (5)	-	-
		1969	457 (3)	115 (3)	-	-
(a)Shirleys Bay	139.5	1968	766 (14)	62 (14)	-	-
	to 138.9	1969	99 (12)	20 (12)	-	-
Watts Creek	139.2	1968	22,130 (5)	3,578 (4)	1,218 (4)	-
	R0.3	1969	1,507 (3)	130 (2)	383 (2)	-
(a)Crystal Bay *	138.9	1968	734 (10)	169 (10)	-	-
	to 138.6	1969	2 (6)	2 (6)	1 (6)	-
(a)Britannia *	136.6	1968	981 (32)	68 (32)	-	-
Beach	to 134.4	1969	690 (9)	200 (9)	-	-
(b)Britannia Water Works Intake	135.8	1968	193 (3)	12 (2)	-	-
(a)Palm Beach *	134.8	1968	641 (5)	69 (5)	-	-
Motel		1969	545 (11)	113 (11)	-	-
(a)Westborro Beach *	132.6	1968	483 (29)	75 (29)	-	-
		1969	690 (6)	172 (6)	-	-

TABLE 2.1 (continued)

Town or Area	Mileage	Year	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml	Fecal Streptococcus per 100 ml	Plate Count per 100 ml
(a) New Edinboro* Canoe Club	130.6	1968	5,137 (6)	387 (6)	-	-
		1969	2,607 (3)	770 (3)	-	-
(b) Chaudiere Bridge	129.6	1968	1,737 (4)	160 (3)	65 (3)	1.0×10^5 (1)
		1969	305 (4)	55 (3)	41 (2)	5.5×10^4 (1)
(a) North of Middle Street	129.9	1968	1,371 (3)	32 (3)	197 (3)	-
		1969	64 (2)	5 (2)	29 (2)	2.5×10^4 (1)
(a) Alexander Bridge Ontario Side	128.9	1968	1,709 (4)	235 (2)	410 (2)	-
(b) Alexander Bridge Mid-River	128.9	1968	1,648 (5)	380 (2)	103 (2)	-
(c) Alexander Bridge Quebec Shore	128.9	1968	1,654 (5)	387 (2)	245 (2)	-
		1969	1,061 (2)	775 (2)	23 (2)	-
Rideau Canal	128.5	1968	2,121 (4)	158 (2)	202 (2)	9.4×10^4 (1)
	R0.0	1969	259 (6)	39 (2)	-	-
Brewery Creek	128.9 (0.0)	1968	4.0×10^4 (7)	1.3×10^4 (4)	3,130 (4)	-
Downstream of Brewery Creek: Sample Point #1.						
(a) Ontario Side	128.3	1969	260 (7)	152 (7)	42 (7)	5.9×10^4 (4)
(c) Quebec Side	128.3	1969	13,253 (5)	2,146 (5)	336 (5)	2.4×10^6 (3)

TABLE 2.1 (continued)

Town or Area	Mileage	Year	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml	Fecal Streptococcus per 100 ml	Plate Count per 100 ml
Downstream of Brewery Creek: Sample Point #2.						
(a)Ontario Side	128.0	1969	11,968 (2)	656 (2)	59 (2)	-
(c)Quebec Side	128.0	1969	5,367 (3)	222 (3)	115 (3)	-
Lake Creek	127.8	1968	2,264 (5)	1,500 (2)	592 (2)	-
	R0.0	1969	1,682 (4)	1,549 (2)	21 (2)	-
Gatineau River	127.4	1968	1,075 (10)	35 (6)	30 (5)	-
	R0.3	1969	899 (8)	224 (4)	50 (4)	-
Rockcliffe Park	127.1	1968	2,352 (8)	183 (2)	110 (2)	-
(a)Narrows Ontario Side		1969	518 (4)	37 (3)	58 (2)	-
(c)Narrows Quebec Side	127.1	1968	6,556 (5)	333 (2)	63 (2)	-
		1969	981 (8)	188 (7)	62 (6)	2.7 x 10 ⁷ (2)
Kettle Island:						
(a)Ontario Side	125.0	1969	2,573 (3)	1,549 (2)	64 (2)	-
(b)Mid-River	125.0	1969	316 (2)	-	-	-
(c)Quebec Side	125.0	1969	2,758 (3)	3,723 (2)	141 (2)	-
Between Kettle Island and Upper Duck Island:						
(a)Ontario Side	123.2	1968	4,900 (11)	916 (2)	212 (2)	-
		1969	1,271 (5)	95 (5)	28 (4)	-
(b)Mid-River	123.2	1968	7,471 (5)	-	-	-
(c)Quebec Side	123.2	1968	6,813 (15)	1,348 (2)	1 (2)	-
		1969	3,088 (6)	139 (5)	144 (4)	-

TABLE 2.1 (continued)

Town or Area	Mileage	Year	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml	Fecal Streptococcus per 100 ml	Plate Count per 100 ml
(a) Between Upper Duck Island and Ontario Shore	122.8	1968	10,639 (5)	491 (3)	85 (3)	-
		1969	765 (3)	46 (2)	-	-
North channel North of Kettle Island on Quebec Side	124.0	1968	16,637 (4)	6,928 (3)	735 (2)	-
		1969	972 (3)	245 (3)	6,928 (2)	-
(b) Upstream of Green Creek	121.0	1968	5,977 (16)	-	-	-
(c) Hiawatha Park Quebec Side	119.5	1968	18,992 (5)	3,256 (2)	141 (2)	-
		1969	30,133 (3)	49 (2)	-	-
(a) Hiawatha Park Ontario Side	119.5	1968	10,274 (5)	-	-	-
		1969	1,040 (4)	16 (3)	31 (2)	-
Lievre River	113.0	1968	2,526 (23)	242 (12)	476 (12)	-
	R 4.9	1969	1,108 (10)	433 (9)	83 (9)	-
(b) Cumberland	112.2	1968	13,047 (15)	2,113 (6)	764 (6)	-
		1969	25,752 (6)	2,860 (6)	143 (4)	-
(a) Upstream of Beckett Creek	110.4	1968	24,840 (8)	-	-	-
(a) Thurso Ferry - between Clarence Island and Ontario shore	102.3	1968	11,801 (8)	2,157 (4)	82 (4)	-
		1969	11,454 (3)	23 (2)	21 (2)	-
(c) Thurso Ferry - between Clarence Island and Quebec shore	102.3	1968	4,890 (12)	1,524 (3)	96 (3)	-
		1969	22,802 (3)	-	-	-

TABLE 2.1 (continued)

Town or Area	Mileage	Year	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml	Fecal Streptococcus per 100 ml	Plate Count per 100 ml
Riviere Blanche	103.0	1968	834 (5)	43 (3)	273 (3)	-
	R1.3	1969	129 (3)	8 (2)	24 (2)	-
(b)Parker Island	101.5	1968	3,943 (20)	-	-	-
South Nation River	94.2	1969	1,405 (4)	810 (4)	6 (4)	-
	R0.0					
(b)Ile Arroussen	87.2	1968	2,039 (15)	496 (5)	1 (5)	-
(b)Montbello	85.6	1968	1,596 (12)	517 (7)	75 (7)	-
		1969	1,488 (4)	20 (4)	12 (4)	3.19 x 10 ⁵ (2)
(a)Downstream of the Kinonge River	84.1	1968	1,738 (6)	-	-	-
Mouth of the Kinonge River	84.5	1968	5,088 (6)	-	-	-
	R0.0					
(a)McTavish Point	78.4	1968	1,162 (7)	-	-	-
(b)L'Orignal	73.2	1968	285 (8)	23 (8)	4 (8)	-
Riviere Rouge	72.4	1968	819 (13)	88 (4)	100 (4)	-
	R0.3	1969	241 (3)	5 (2)	53 (2)	-
(b)Upstream of Hawkesbury	69.1	1968	378 (10)	68 (4)	4 (4)	-

TABLE 2.1 (continued)

Town or Area	Mileage	Year	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml	Fecal Streptococcus per 100 ml	Plate Count per 100 ml
(b) Hawkesbury 1st Bridge	68.1	1968	1,130 (6)	29 (4)	34 (3)	-
		1969	910 (2)	11 (2)	-	-
(b) Hawkesbury 2nd Bridge	68.1	1968	817 (6)	71 (4)	35 (3)	-
		1969	1,702 (2)	13 (2)	-	-
(b) Perley Bridge Hawkesbury	68.0	1968	1,180 (7)	31 (9)	6 (8)	1.0 x 10 ⁵ (3)
		1969	492 (7)	4 (6)	5 (4)	-
(c) Perley Bridge Quebec Shore	68.0	1968	725 (5)	161 (3)	21 (2)	-
		1969	559 (2)	13 (2)	25 (2)	-
(c) One Mile Down- stream of Perley Bridge Quebec Side	67.1	1968	7,690 (4)	-	340 (1)	-
(b) One Mile Down- stream of Perley Bridge (Mid)	67.1	1968	671 (4)	160 (1)	2 (1)	-
(a) One Mile Down- stream of Perley Bridge Ontario Side	67.1	1968	390 (5)	70 (1)	4 (1)	-
Steven Shoal	65.5	1968	596 (8)	-	-	-
Greeces Point	62.3	1968	3,590 (8)	-	-	-

TABLE 2.1 (continued)

Town or Area	Mileage	Year	Total Coliforms per 100 ml	Fecal Coliforms per 100 ml	Fecal Streptococcus per 100 ml	Plate Count per 100 ml
(a) Two Miles Upstream of Carillon	58.4	1968	2,250 (18)	-	-	-
(b) Carillon	56.8	1968	851 (25)	110 (13)	7 (13)	9.6 x 10 ⁴ (1)
		1969	306 (10)	29 (10)	8 (10)	-
North River	51.3	1968	1,600 (4)	54 (3)	252 (3)	-
	R3.1	1969	236 (1)	188 (1)	150 (1)	-
Rigaud River	50.0	1968	4,390 (4)	5,181 (2)	193 (3)	-
	R1.8	1969	2,400 (2)	2,399 (2)	398 (2)	-
Point A (Masson)	47.5	1968	350 (8)	-	-	-
(b) Oka Ferry	39.1	1968	329 (22)	25 (8)	24 (8)	-
		1969	240 (7)	109 (6)	48 (6)	-

* Bacteriological results courtesy of the Ottawa-Carleton East View Health Unit, Dr. L.H. Douglas, for bathing areas on the Ottawa and Rideau rivers from 1954 to 1968.

FIGURES 2.1-3

BACTERIOLOGICAL RESULTS

OTTAWA RIVER

Note:

1. The results listed in Table 2.1 are presented graphically for both 1968 and 1969.
2. The logarithm number of total coliform, fecal coliform and fecal streptococcus are represented by the height of the bars, and the location of the point is determined by the mileage on the Ottawa River (see Zone Maps in Introduction). The top chart refers to sample points on the Ottawa River itself while the lower chart refers to the tributaries that empty into the Ottawa River.

FIGURE 2.1
SUMMARY OF BACTERIAL CONDITIONS IN
THE OTTAWA RIVER AND TRIBUTARIES
OF ZONES 1 AND 2
(a) 1968

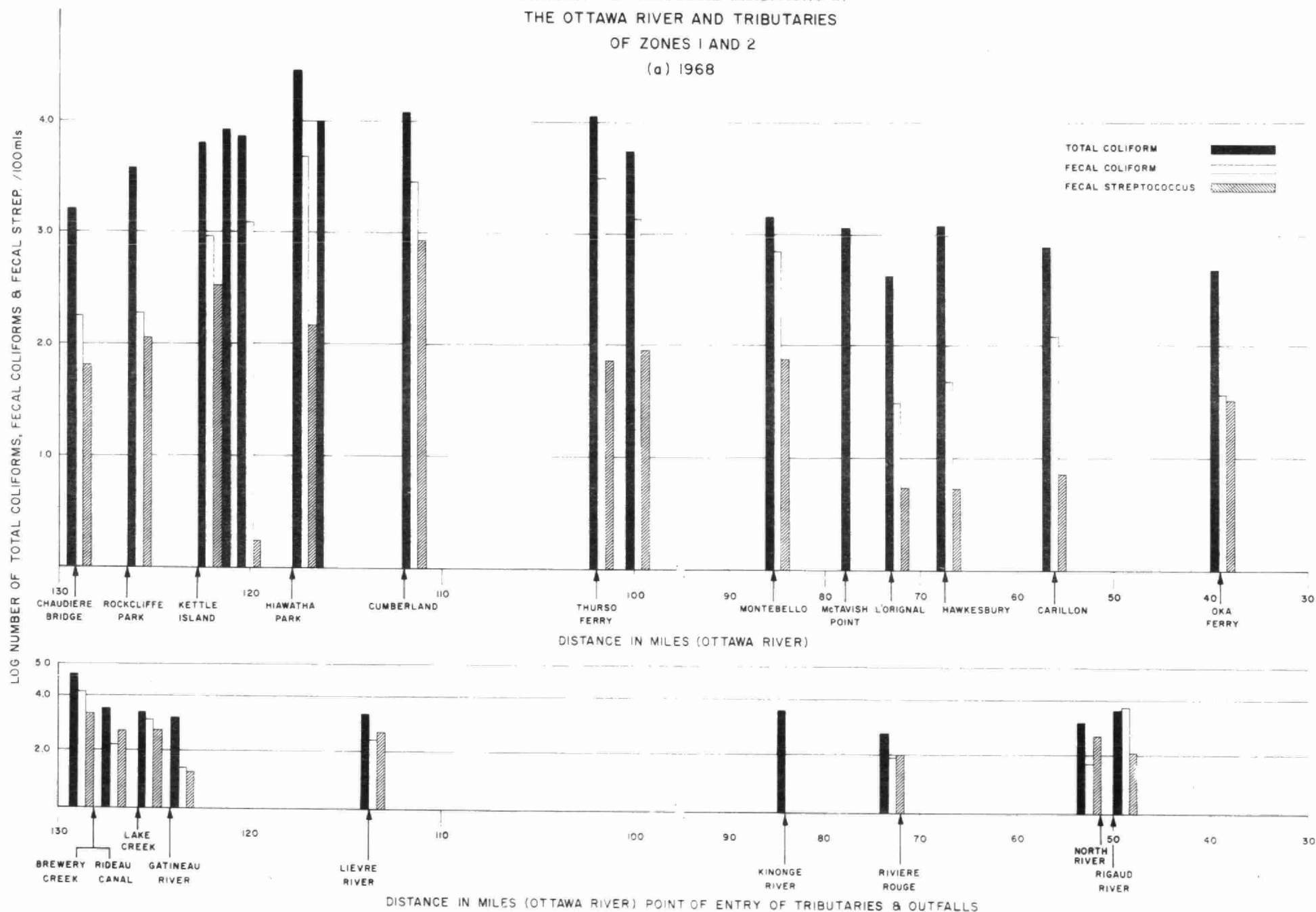


FIGURE 2.1
SUMMARY OF BACTERIAL CONDITIONS IN
THE OTTAWA RIVER AND TRIBUTARIES
OF ZONES 1 AND 2
(b) 1969

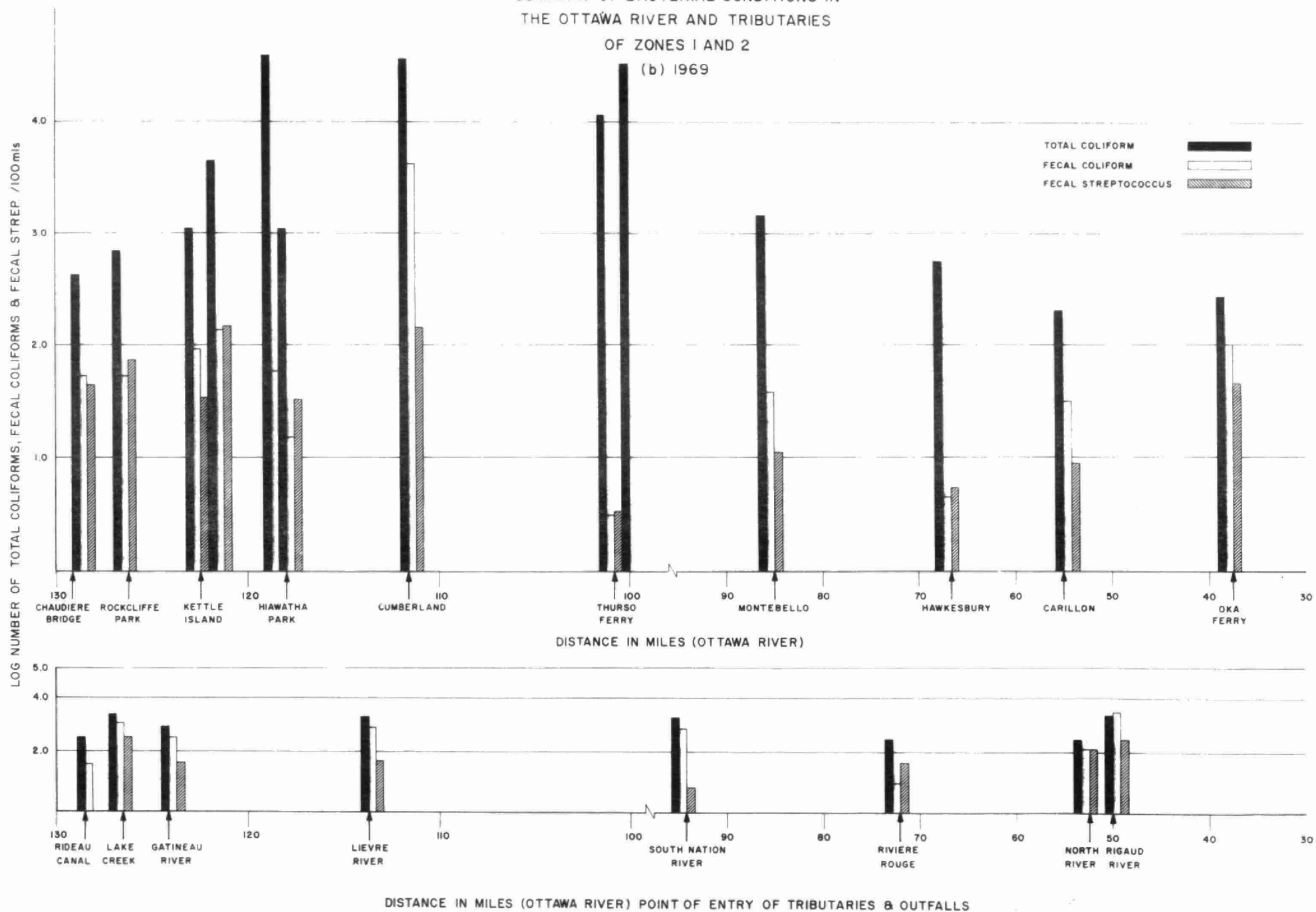


FIGURE 2.2
SUMMARY OF BACTERIAL CONDITIONS IN
THE OTTAWA RIVER AND TRIBUTARIES
OF ZONE 3
(a) 1968

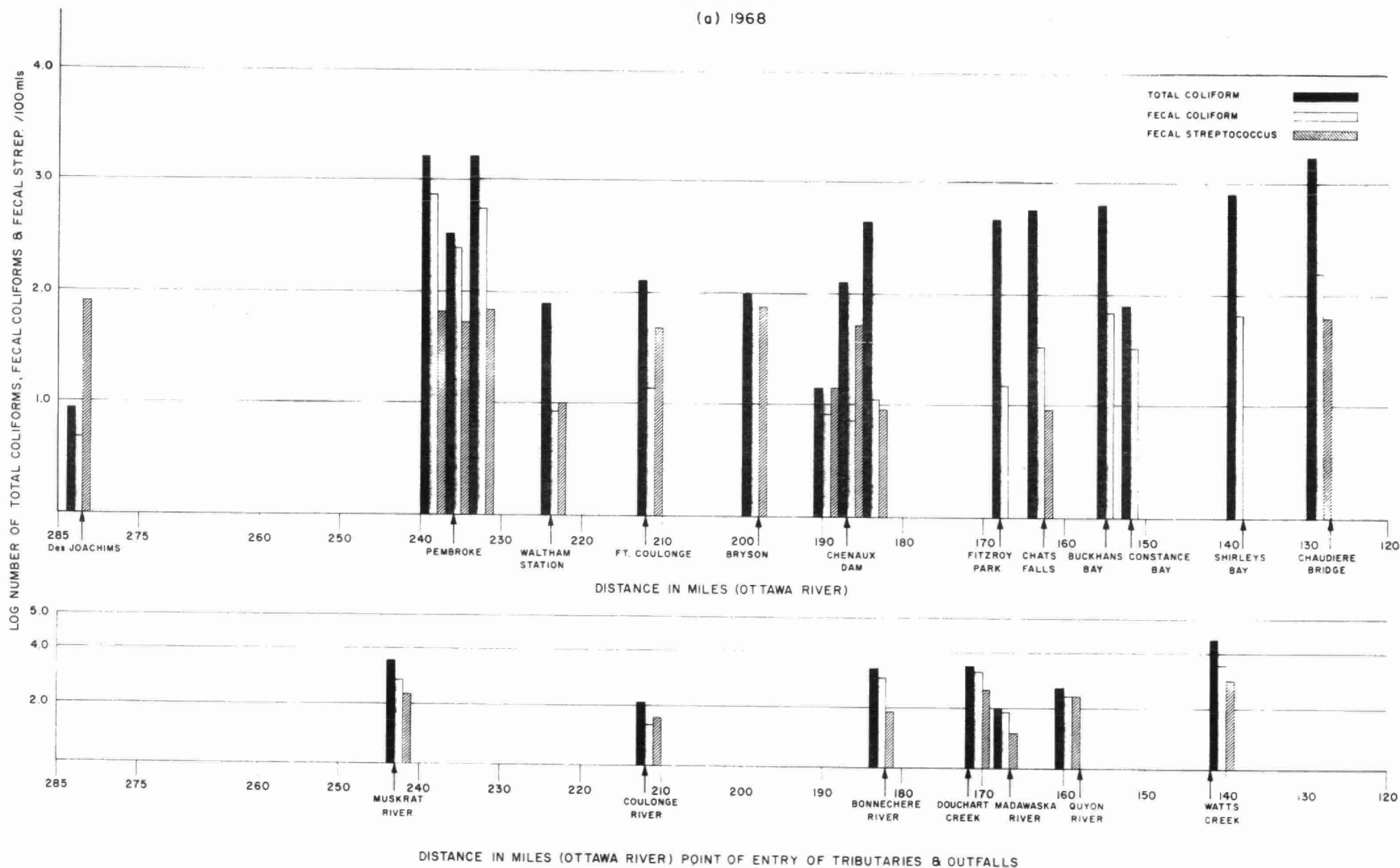


FIGURE 2.2
SUMMARY OF BACTERIAL CONDITIONS IN
THE OTTAWA RIVER AND TRIBUTARIES
OF ZONE 3
(b) 1969

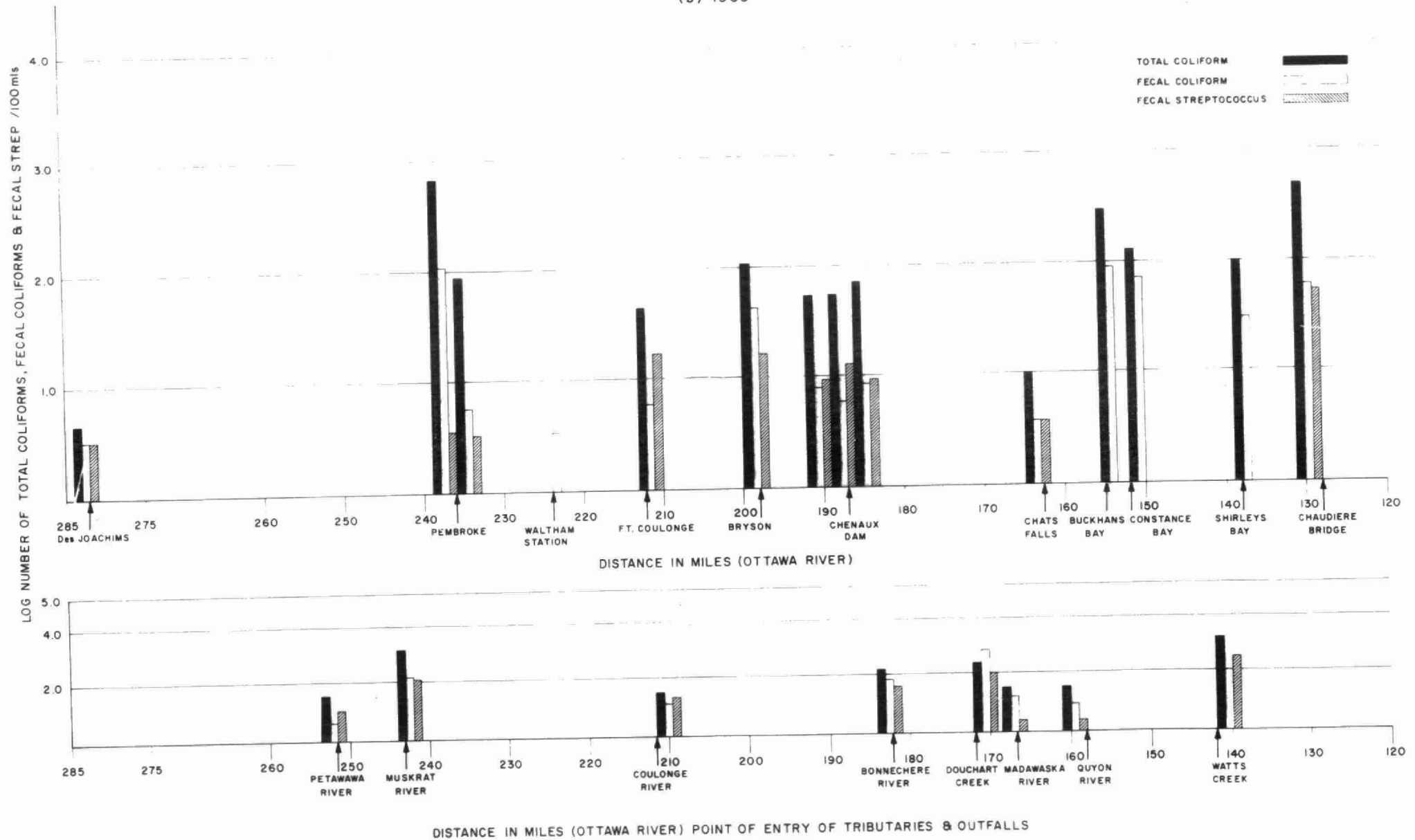


FIGURE 2.3
SUMMARY OF BACTERIAL CONDITIONS IN
THE OTTAWA RIVER AND TRIBUTARIES
OF ZONE 4
(a) 1968

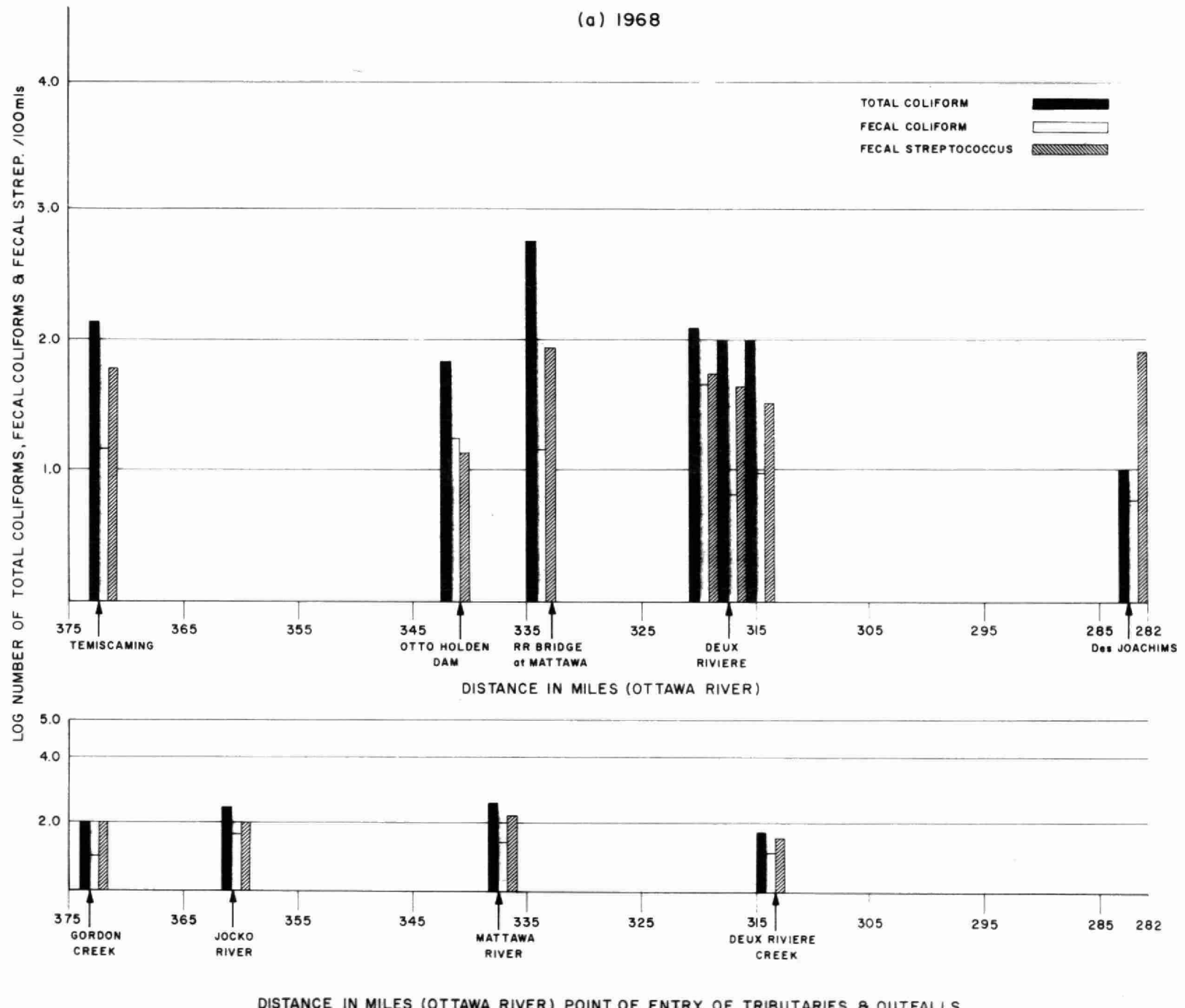
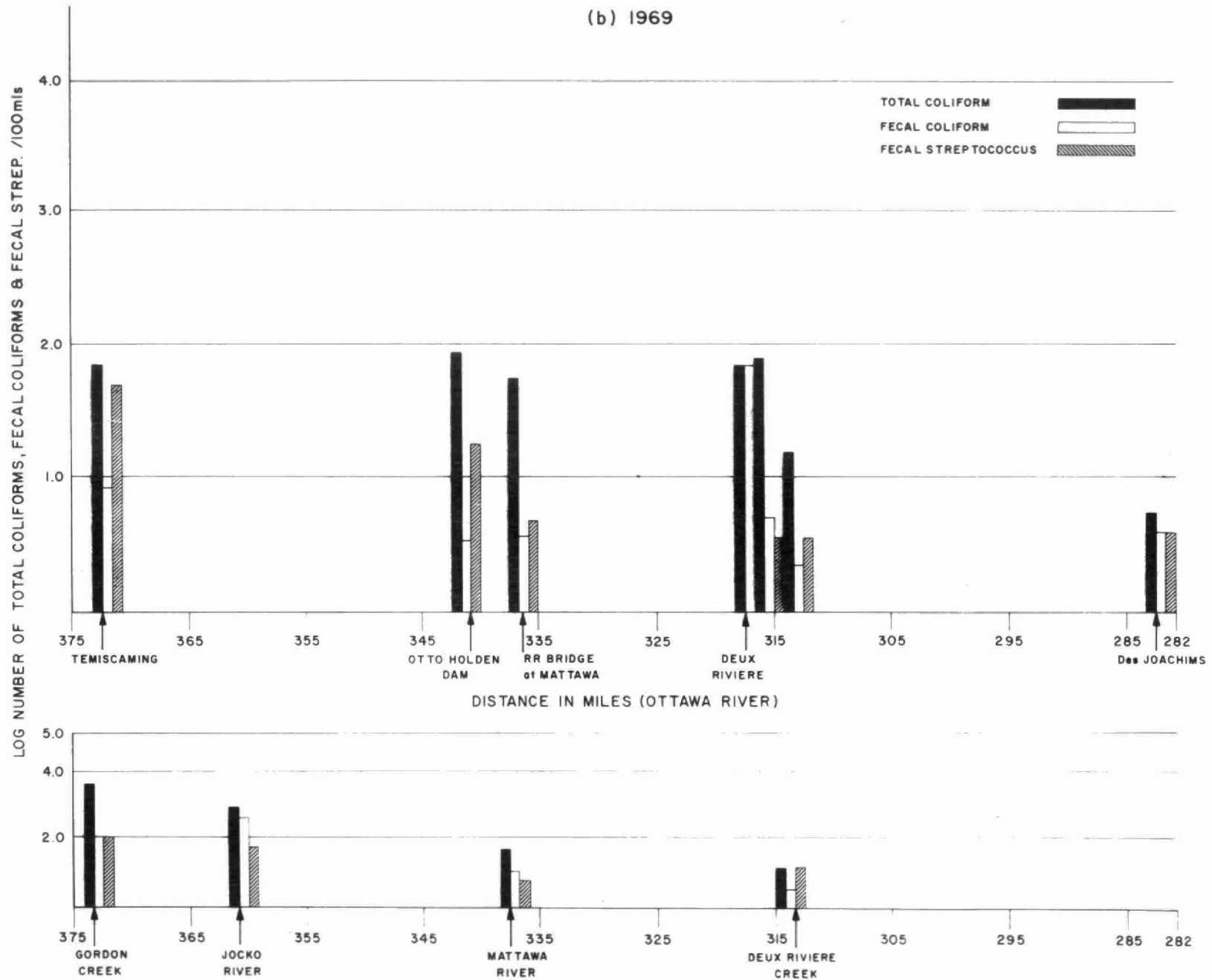


FIGURE 2.3
SUMMARY OF BACTERIAL CONDITIONS IN
THE OTTAWA RIVER AND TRIBUTARIES
OF ZONE 4
(b) 1969



CHAPTER 3

CHEMICAL AND PHYSICAL

3.1 SCOPE OF STUDIES

Most of the data presented in this chapter were collected during a special water quality surveillance program in 1969-1970. The 333 mile stretch of the Ottawa River from Oka to Temiskaming was monitored at 31 locations. A further 29 stations on the major tributaries to the river were also sampled as part of the monthly monitoring program. In addition, continuous recording water quality meters are maintained by the Ontario Water Resources Commission at the Otto Holden and Carillon generating stations.

In 1966, a special program was initiated to monitor the nuclear power plants at Rolphton and the nuclear laboratories at Chalk River. Water samples are taken for radiological analyses at nine stations in the Rolphton and Chalk River area.

Some of the temperature characteristics of the Ottawa River are also documented in this chapter. Some typical trends with respect to time and depth are presented.

3.2 METHODOLOGY

All samples collected in the monitoring program were analyzed for BOD₅, total and dissolved P, total kjeldahl, nitrogen ammonia, nitrite and nitrate by the Ontario Water Resources Commission laboratories. In some cases, a field laboratory was used, but samples requiring special analyses were shipped to the main laboratories in Toronto. Both temperature and dissolved oxygen were measured in situ using an Hach Kit and a standard thermometer. All analyses were made using the techniques described in a separate report (OWRC, 1970), except for sulphates which were measured by a turbidimetric procedure.

The samples collected for radiological analyses are handled by the Radiation Protection Division of National Health and Welfare, and by the Radiation Protection Service of the Department of Health of Ontario.

Temperature-time data were collected by the robot monitors. The temperature-depth data were collected by temperature probes (Figure 3.2 (a) (b)) and by bathythermograph (Figure 3.2 (c)).

3.3 RESULTS

3.3.1 Water Quality Monitoring

The water quality monitoring results are summarized in Table 3.1 for stations in the Ottawa River and in Table 3.2 for stations at the mouths of the major tributaries. At most locations, the average results for all the stations are across the river or for only one station on the range are presented. However, the results for all of the stations are reported for the Carillon Dam and Oka Ferry ranges where the difference between stations was pronounced.

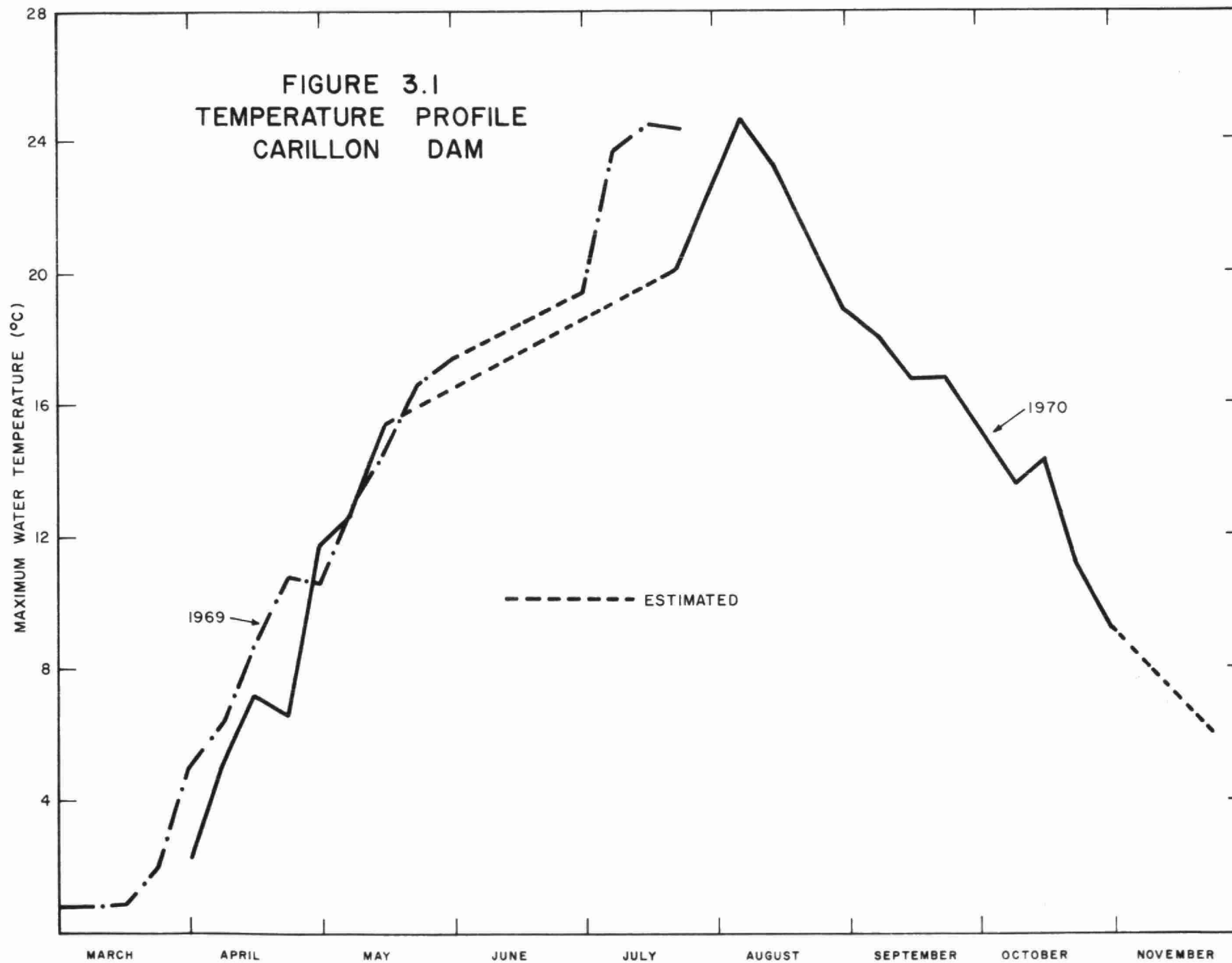
3.3.2 Radiological

Since detailed summaries of the radiological results for the water samples taken in the Ottawa River can be obtained from the quarterly reports published by the Department of National Health and Welfare (1969-1970), duplication of that data are not presented here.

3.3.3 Temperature

Figure 3.1 illustrates the temperature trends that are characteristic of the Ottawa River. Average water temperatures approach 0°C during the months of December through March and reach a peak of about 25°C during July and August, with reasonably linear graduations between these minimum and maximum levels.

Thermal profiles were taken at selected ranges in the Upper Ottawa in July 1969. Although they are not necessarily representative of all sections of the river, they do illustrate the thermal conditions typical of some natural and artificial lakes during summer weather conditions. Even though a true thermocline does not occur, the temperature drops sharply below the depths of 50 feet for the two stations upstream of the Otto Holden generating station (Figure 3.2 (a) (b)), and below 85 feet for the stations in Lake Rocher-Fendu. Also, due to the protected nature and the depths of the areas, the thermal conditions would likely be stable enough to persist throughout the warm water period. This also implies that, with little mixing below these depths, the reoxygenation of the deeper waters would become increasingly difficult. Under conditions of high surface water temperature and low stream-flow, there is a strong possibility of extremely low concentrations of dissolved oxygen in the lower waters. Further thermal profiles can be obtained from the Department of Lands and Forests of Ontario.



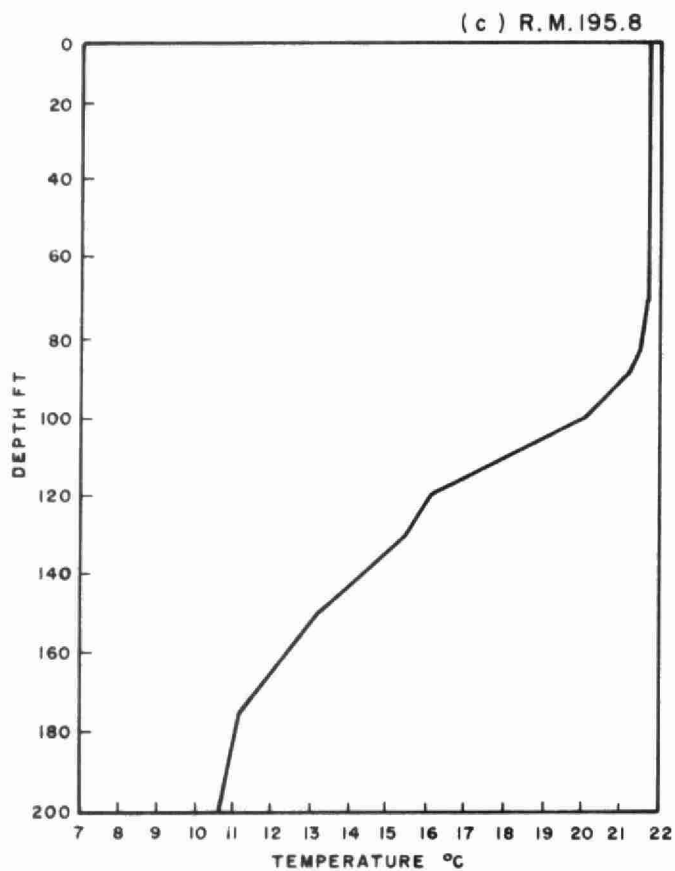
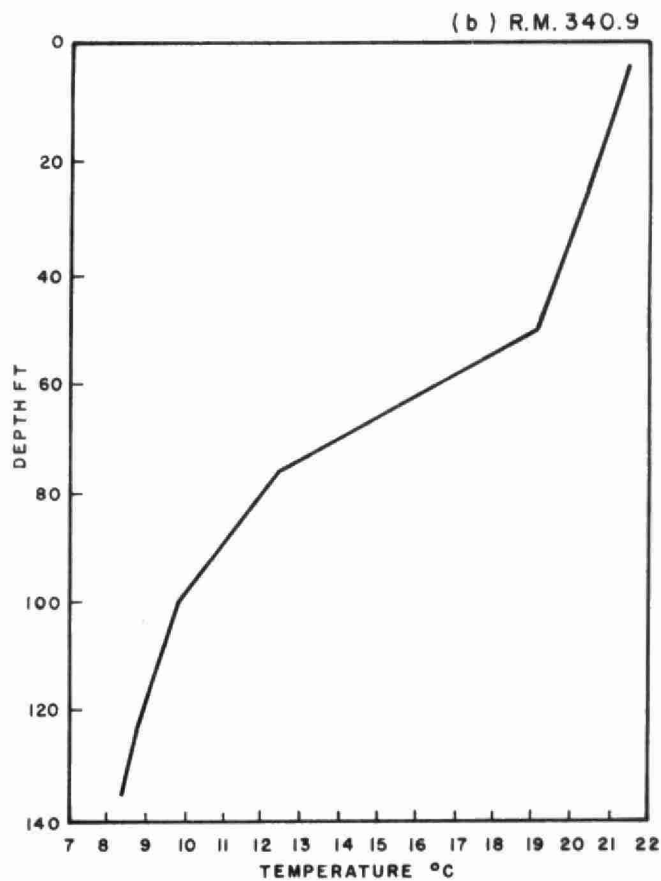
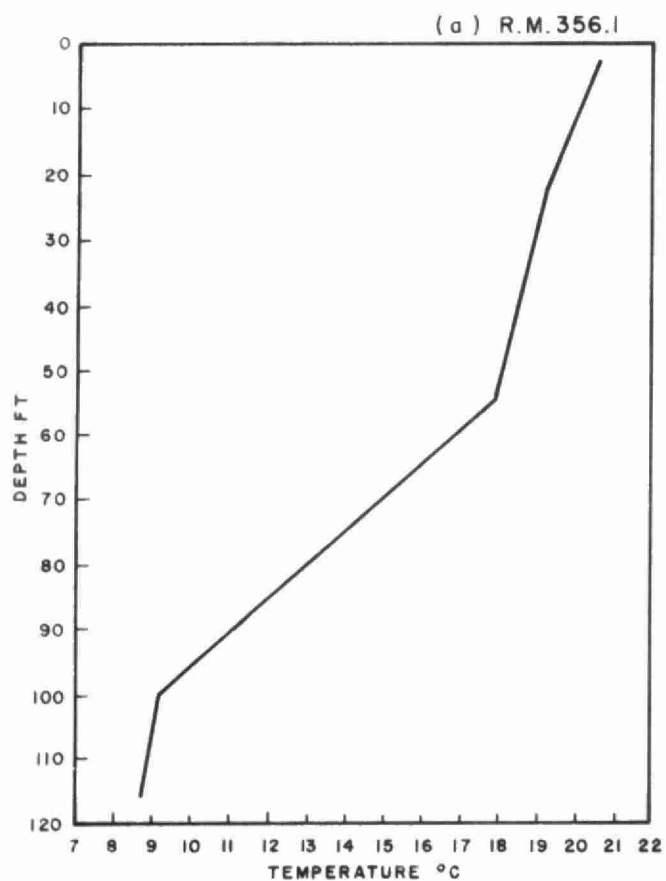


FIGURE 3.2 THERMAL PROFILES JULY 28, 1969 OTTAWA RIVER

REFERENCES

Canada Department of National Health and Welfare, 'Radiation Surveillance in Canada', Quarterly Reports, 1968-1970.

Ontario Department of Lands and Forests, Lake Inventory Unit.

Ontario Water Resources Commission, 'Outlines of Analytical Methods', Division of Laboratories, 1970.

TABLE 3.1

WATER QUALITY MONITORING DATA
OTTAWA RIVER

Note:

1. All results are averages reported in mg/l, except for pH (standard pH units), coliforms (median, total number per 100 ml), turbidity (standard Jackson units), phenol (μ g/l) and conductivity (micromhos).
2. The term "composite" sample refers to the case where a number of samples across the river at one river mileage are combined prior to analysis.

TABLE 3.1
MONITORING DATA
OTTAWA RIVER

Oka Ferry (RM 39.0) ✓
(composites)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total solids	68	68	72	64	2
	69	90	110	70	3
Suspended solids	68	4	5	4	2
	69	7	10	2	3
Turbidity (Jackson units)	68	4.0	8	0	2
	69	5.7	8	3.1	3
Conductivity (micromhos)	68	76	77	76	2
	69	100	123	82	3
Chloride	68	3	3	3	2
	69	4	5	4	2
Hardness (as CaCO ₃)	68	34	36	32	2
	69	44	54	37	3
Alkalinity (as CaCO ₃)	68	22	24	21	2
	69	37	57	23	3
Total Iron (as Fe)	68	.56	.70	.42	2
	69	.50	.70	.30	3
pH	68	7.1	7.3	6.9	2
	69	7.4	7.9	7.0	3
Phenol	68	5	6	4	2
	69	3	8	0	3
Total arsenic	68	.0			1
	69	.02			1
COD	68	30	31	28	2
	69	33	42	27	3
Chromium (as Cr)	68	0			2
	69	0			3
Cyanide	68	.01	.02	.0	2
	69	.01	.03	.0	2
Fluoride	68	.1	.1	.1	2
	69	.1	.2	.1	3
Sulphate	68	15.0	15.0	15.0	2
	69	13.0	14.0	12.0	3
Lead (as Pb)	68	.09	.19	.0	2
	69	0.03	0.09	.0	3

TABLE 3.1 (continued)

Oka Ferry (cont'd)
(1650')

Parameter	Year	Average	Maximum	Minumum	No. of Samples
Dissolved oxygen	68	7.0	8.0	6.0	5
	69	10.0	10.5	9.0	4
BOD	68	1.2	2.2	.5	7
	69	1.3	2.4	.6	4
Phosphorus					
Total (as P)	68	.046	.08	.01	7
	69	.04	.05	.04	4
Soluble (as P)	68	.02	.046	.003	7
	69	.01	.02	.01	4
Nitrogen					
NH ₃ (as N)	68	.14	.32	.04	7
	69	.05	.07	.02	4
NO ₂ (as N)	68	.01	.02	.00	7
	69	.0	.01	.0	4
NO ₃ (as N)	68	.08	.14	.01	7
	69	.13	.18	.09	4
Total Kjeldahl (as N)	68	.58	1.1	.34	7
	69	.51	.66	.35	4
Coliforms	68	710	21,000	88	5
	69	485	1,170	192	4

(3300')

Dissolved oxygen	68	7.2	8.0	5.5	5
	69	9.0	11.0	4.6	6
	70	8.8	11.0	8.0	4
BOD	68	1.3	2.2	.8	7
	69	1.0	2.2	.5	6
	70	1.0	1.0	1.0	3
Phosphorus					
Total (as P)	68	.07	.16	.03	7
	69	.05	.06	.4	6
	70	.03	.04	.02	3
Soluble (as P)	68	.03	.11	.01	7
	69	.02	.04		6
	70	.01	.01	.0	3
Nitrogen					
NH ₃ (as N)	68	.1	.17	.06	7
	69	.06	.07	.04	6
	70	.1	.11	.09	3
NO ₂ (as N)	68	.01	.02	.0	7
	69	.0	.01	.0	6
	70	.01	.02	.0	3
NO ₃ (as N)	68	.08	.13	.0	7
	69	.12	.19	.08	6
	70	.16	.19	.13	3

TABLE 3.1 (continued)

Oka Ferry (cont'd)
(3300')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total Kjeldahl	68	.58	1.46	.06	7
(as N)	69	.63	.95	.38	6
	70	.59	.88	.34	3
COD	69	59	60	58	2
	70	28	30	25	2
Fluoride	70	.1	.2	.1	3
		.1			1
Total solids	69	75	80	70	2
	70	70	80	60	3
Suspended solids	69	7	10	5	2
	70	6	10	5	3
Turbidity					
(Jackson Units)	69	7	10	4	2
	70	4.5	7.5	3	3
Conductivity					
(micromhos)	69	78	79	77	2
	70	77	95	68	3
Chloride	69	4	4	4	2
	70	3	3	3	3
Hardness	69	30			1
Alkalinity	69	44	54	34	3
Total Iron					
(as Fe)	69	.40			1
	70	.50	.70	.30	3
pH	69	7.3			1
	70				
Coliforms	68	490	17,000	24	5
	69	430	2,000	224	6
	70	14	32	4	4
(4950')					
Dissolved oxygen	68	7.6	10.0	5.5	6
	69	10.6	11.0	9.5	4
BOD	68	1.0	1.2	.9	7
	69	1.0	1.6	.5	4
Phosphorus					
Total (as P)	68	.046	.08	.02	7
	69	0.04	0.05	0.04	4
Soluble (as P)	68	.02	.06	.01	7
	69	.01	.02	.0	4
Nitrogen					
NH ₃ (as N)	68	.1	.2	.01	7
	69	.06	.12	.02	4
NO ₂ (as N)	68	.01	.02	.0	7
	69	.0	.01	.0	4
NO ₃ (as N)	68	.08	.13	.0	7
	69	.13	.19	.09	4
Total Kjeldahl					
(as N)	68	.41	.8	.15	7
	69	.5	.7	.43	4
Coliforms	68	6,000	33,000	172	5
	69	250	432	168	3

TABLE 3.1 (continued)

Carillon Dam (RM 56.8) ✓
(400')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved oxygen	68	7.4	11.0	5.0	7
	69	10.6	11.5	9.0	6
BOD	68	2.2	8.0	.08	8
	69	1.6	3.0	.9	6
Phosphorus					
Total (as P)	68	.04	.06	.03	8
	69	.04	.08	.02	6
Soluble (as P)	68	.01	.04	.003	8
	69	.01	.03	.00	6
Nitrogen					
NH ₃ (as N)	68	.18	.59	.04	8
	69	.10	.28	.02	6
NO ₂ (as N)	68	.01	.03	.0	8
	69	.0	.01	.0	6
NO ₃ (as N)	68	.06	.13	.0	8
	69	.17	.32	.07	6
Total Kjeldahl (as N)	68	.94	2.0	.08	8
	69	.63	.92	.36	6
Coliforms	68	3,700	59,000	292	5
	69	430	2,500	56	5

(800')

Dissolved oxygen ✓	68	7.6	11.0	5.0	6
	69	10.0	11.0	4.0	9
	70	10.4	13.0	8.0	8
BOD ✓	68	1.3	1.8	.7	7
	69	1.3	3.4	.06	9
	70	1.8	3.3	1.0	7
Phosphorus					
Total (as P) ✓	68	.04	.06	.01	7
	69	.04	.09	.02	9
	70	.03	.06	.02	7
Soluble (as P) ✓	68	.01	.016	.01	7
	69	.01	.02	.02	8
	70	.003	.0	.0	7
Nitrogen					
NH ₃ (as N) ✓	68	.11	.21	.05	7
	69	.06	.23	.01	9
	70	.12	.19	.08	7
NO ₂ (as N) ✓	68	.01	.02	.0	7
	69	.01	.01	.0	9
	70	.01	.02	.0	7
NO ₃ (as N) ✓	68	.06	.13	.0	7
	69	.15	.41	.04	9
	70	.15	.24	.08	7

TABLE 3.1 (continued)

Carillon Dam (RM 56.8) (cont'd)
(800')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total Kjeldahl ✓ (as N)	68	.68	1.1	.42	7
	69	.64	1.0	.43	9
	70	.54	.92	.4	8
Coliforms ✓	68	2,000	3,900	276	4
	69	1,200	3,300	60	8
	70	246	530	4	8

(1200')

Dissolved oxygen	68	7.4	10.0	5.0	7
	69	11.3	11.5	10.0	6
BOD	68	1.4	1.9	1.0	8
	69	1.5	2.2	.9	6
Phosphorus					
Total (as P)	68	.04	.06	.02	8
	69	.03	.05	.2	6
Soluble (as P)	68	.02	.04	.003	8
	69	.0	.01	.0	5
Nitrogen					
NH ₃ (as N)	68	.14	.29	.04	8
	69	.07	.26	.01	6
NO ₂ (as N)	68	.01	.03	.0	8
	69	.0	.1	0	6
Total Kjeldahl (as N)	68	.63	1.8	.10	8
	69	.63	1.1	.28	6
Coliforms ✓	68	2,000	42,000	356	5
	69	924	2,000	72	6

(1600')

Dissolved oxygen	68	7.1	9.5	5.0	6
	69	11.6	12.0	11.5	4
BOD	68	1.4	2.3	.8	7
	69	1.4	2.0	.8	4
Phosphorus					
Total (as P)	68	.03	.05	.01	7
	69	.03	.05	.02	4
Soluble (as P)	68	.01	.03	.003	7
	69	.01	.01	.0	3
Nitrogen					
NH ₃ (as N)	68	.12	.2	.06	7
	69	.04	.07	.01	4

TABLE 3.1 (continued)

Carillon Dam (RM 56.8) (cont'd)
(1600')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
NO ₃ (as N)	68	.07	.15	.0	7
	69	.19	.4	.07	4
NO ₂ (as N)	68	.01	.02	.0	7
	69	.0	.01	.0	4
Total Kjeldahl (as N)	68	.79	1.8	.4	7
	69	.58	.82	.29	4
Coliforms	68	1,900	2,500	292	4
	69	450	524	284	3

(2000')

Dissolved oxygen	68	7.5	10.0	5.0	6
	69	11.0	11.5	10.4	4
BOD	68	1.2	2.1	.4	7
	69	1.5	2.0	.9	4
Phosphorus					
Total (as P)	68	.04	.07	.03	7
	69	.05	.1	.02	4
Soluble (as P)	68	.013	.02	.006	7
	69	.0	.01	.0	3
Nitrogen					
NH ₃ (as N)	68	.11	.24	.05	7
	69	.04	.05	.02	4
NO ₃ (as N)	68	.08	.14	.0	7
	69	.13	.19	.06	4
NO ₂ (as N)	68	.01	.03	.00	7
	69	.0	.01	.0	4
Total Kjeldahl (as N)	68	.47	.85	.12	7
	69	.58	1.0	.29	4
Coliforms	68	2,500	40,000	344	4
	69	432	552	312	2

TABLE 3.1 (continued)

Carillon Dam (cont'd)
Composite (800') (special analyses)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total solids	69	71	80	65	3
	70	71	190	40	7
Suspended solids	69	5	5	5	3
	70	17	80	5	7
Turbidity (Jackson units)	69	9.7	16	4	3
	70	11.4	50	3	7
Conductivity (micromhos)	69	68	92	36	3
	70	77	122	36	7
Chloride	69	3	4	3	3
	70	3	5	3	7
Hardness (as CaCO ₃)	69	31	34	28	2
	70	37	52	24	5
Alkalinity (as CaCO ₃)	69	26	32	23	3
	70	25	43	17	6
Total Iron (as Fe)	69	.35			1
	70	.86	2.30	.35	4
pH	69	7.6	8.1	7.2	3
	70	7.2	7.7	6.9	7
Phenol	69	.007	.008	.006	3
	70	.007	.010	.00	5
Arsenic	69	.01	.02	.01	2
	70	.0	.02	.0	4
COD	69	35	60	16	3
	70	25	30	20	7
Chromium (as Cr)	70	0			2
Copper (as Cu)	69	0			1
	70	.01	.03	0	3
Cyanide	69	0			1
	70	0			3
Fluoride	69	.1	.1	.0	3
	70	.2	.3	.1	4
Sulphate	69	12	13	10	3
	70	14	17	10	7
Lead (as Pb)	69	.0			1
	70	.07	.28	.0	4
Zinc (as Zn)	69	.07			1
	70	.01	.03	.0	2

TABLE 3.1 (continued)

Carillon Dam
At site of robot monitor
(800')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved oxygen	69	11.5	11.5	11.5	4
BOD	69	1.4	2.0	.8	4
Phosphorus					
Total (as P)	69	.03	.05	.02	4
Soluble (as P)	69	.01	.02	.01	4
Nitrogen					
NH ₃ (as N)	69	.06	.07	.05	4
NO ₂ (as N)	69	0.00	.01	0.00	4
NO ₃ (as N)	69	.16	.19	.11	4
Total Kjeldahl (as N)	69	.41	.46	.35	4
Coliforms	69	730	1,500	64	4

TABLE 3.1 (continued)

Perley Bridge ✓ (RM 68.0)					
Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved oxygen ✓	68	7.8	8.5	5.0	29
	69	10.5	12.0	5.4	48
	70	9.1	13.0	7.0	7
BOD ✓	68	2.3	12.6	.04	29
	69	2.1	6.9	.4	8
	70	5.6	20	.6	8
Phosphorus					
Total (as P) ✓	68	0.043	0.08	.007	23
	69	.04	.05	.03	8
	70	0.04	0.08	0.02	8
Soluble (as P) ✓	68	0.013	0.04	0.003	24
	69	0.02	0.04	0.0	4
	70	0.01	0.04	0.0	8
Nitrogen					
NH ₃ (as N) ✓	68	.16	.65	.02	27
	69	.12	.66	.02	10
	70	.19	.57	.06	7
NO ₂ (as N) ✓	68	0.0	.02	0.0	27
	69	0.01	0.01	.0	7
	70	0.01	0.02	.0	8
NO ₃ (as N) ✓	68	0.07	.15	.0	27
	69	0.09	.22	.05	7
	70	.13	.23	.07	8
Total Kjeldahl ✓ (as N)					
	68	.77	3.9	.2	27
	69	.48	.54	.42	2
	70	1.03	2.2	.39	8
Total Solids ✓	68	69	90	50	6
	69	66	70	60	3
	70	83	180	50	
Suspended Solids ✓	68	8	15	2	6
	69	8	5	3	3
	70	13	55	5	8
Turbidity (Jackson Units) ✓					
	68	8.7	10	6.5	6
	69	8.7	10	6	3
	70	15.0	40	2	6
Conductivity ✓ (micromhos)					
	68	88	97	79	6
	69	79	92	70	3
	70	85	128	66	7
Chloride ✓	68	4	5	2	6
	69	3	4	3	3
	70	3	6	3	8

TABLE 3.1 (continued)

Perley Bridge (cont'd)
(RM 68.0)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Hardness					
(as CaCO_3)	68	38	44	32	6
	69	28			1
	70	38	56	24	3
Alkalinity					
(as CaCO_3)	68	27	32	24	6
	69	22			1
	70	27	43	16	3
Total Iron					
(as Fe)	68	.57	.77	.33	6
	69	.40			1
	70	1.28	3.00	.38	3
COD	69	46	60	30	3
	70	37	80	20	8
Sulphate	69	12	16	10	3
	70	13	18	7	7
Phenol	68	6			
pH	68	7.3	8.4	6.9	6
	69	7.5			1
	70	7.3	7.6	7.0	3
Coliforms ✓	68	2,000	58,000	242	21
	69	1,600	3,200	224	6
	70	158	3,500	4	8

TABLE 3.1 (continued)

Thurso Ferry ✓
(RM 102.3)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved oxygen	68	6.8	9.0	5.5	13
	69	10.1	11.5	5.8	10
	70	7.7	8.0	7.0	3
BOD	68	2.9	6.4	.5	13
	69	2.6	7.8	.04	10
	70	1.2	1.6	1.0	3
Phosphorus					
Total (as P)	68	.06	.1	.0	13
	69	.05	.08	.03	8
	70	.04	.06	.03	3
Soluble (as P)	68	.013	.03	.003	13
	69	.02	.03	.0	6
	70	.01	.01	.01	3
Nitrogen					
NH ₃ (as N)	68	.08	.17	.03	13
	69	.04	.10	.01	8
	70	.11	.13	.07	3
NO ₂ (as N)	68	.0	.02	.0	13
	69	.0			1
	70	.01	.01	.0	3
NO ₃ (as N)	68	.04	.13	.01	13
	69	.12	.17	.01	6
	70	.11	.13	.09	3
Total Kjeldahl (as N)	68	.58	.86	.15	13
	69	.61	.92	.42	10
	70	.53	.75	.32	3
Total Solids	68	66	96	41	5
	69	75	85	70	3
	70	65	70	60	3
Suspended Solids	68	11	24	4	5
	69	4	5	2	3
	70	8	10	5	3
Turbidity (Jackson units)	68	5.1	11	3.1	5
	69	5.0	6	4	2
	70	8.2	15	3	3
Conductivity (micromhos)	68	76	121	52	5
	69	92	116	69	3
	70	73	84	67	3
Chloride	68	3	9	2	5
	69	3	4	3	3
	70	3	4	3	3

TABLE 3.1 (continued)

Thurso Ferry (cont'd)
(RM 102.3)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
COD	68	36	27	16	5
	69	55	82	24	3
	70	25	30	15	3
Sulphate	68	16	19	14	5
	69	10			1
	70	12			1
Hardness	69	29			1
	70	34			1
Alkalinity (as CaCO ₃)	69	22			1
	70	20			1
Total Iron (as Fe)	69	.45			1
	70	.60			1
pH	69	7.1			1
	70	7.4			1
Coliforms	68	6,000	11,800	0	6
	69	10,000	180,000	700	9
	70	88	328	4	3

TABLE 3.1 (continued)

Cumberland Ferry
(RM 112.3)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved Oxygen	68	7.3	10.6	5.5	20
	69	9.1	11.5	6.2	16
	70	9.8	10.0	9.5	3
BOD	68	2.2	6.8	.8	20
	69	2.4	8.0	.08	16
	70	1.0	1.2	.8	4
Phosphorus					
Total (as P)	68	.06	.15	.03	20
	69	.07	.24	.02	15
	70	.05	.07	.03	4
Soluble (as P)	68	.02	.13	.01	20
	69	.03	.19	.0	15
	70	.02	.03	.01	4
Nitrogen					
NH ₃ (as N)	68	.07	.19	.01	20
	69	.03	.12	.01	15
	70	.07	.14	.04	4
NO ₂ (as N)	68	.0	.02	.0	20
	69	.0	.0	.0	15
	70	.01	.03	.0	4
NO ₃ (as N)	68	.05	.10	.01	20
	69	.05	.12	.0	15
	70	.04	.08	.0	4
Total Kjeldahl (as N)	68	.38	.9	.11	20
	69	.46	.83	.04	15
	70	.43	.62	.32	3
Total Solids	68	55	62	46	3
	69	67	90	60	4
	70	60	65	55	4
Turbidity (Jackson units)	68	3.6	8.5	0	4
	69	7.5	10	6	3
	70	5.0	8	3	4
Conductivity (micromhos)	68	74	86	61	4
	69	74	86	61	4
	70	59	67	54	4
Chloride	68	2	3	2	4
	69	2	3	2	3
	70	2	3	1	4
Hardness (as CaCO ₃)	69	29			1
	70	29			1

TABLE 3.1 (continued)

Cumberland Ferry (cont'd)
(RM 112.3)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Alkalinity (as CaCO_3)	69	21			1
	70	16			1
Total Iron (as Fe)	69	.35			1
	70	.25			1
Suspended Solids	68	5	7	3	4
	69	7	10	5	4
	70	11	20	5	4
COD	68	24	40	11	4
	69	41	55	28	3
	70	28	30	25	4
Sulphate	68	13	17	8	4
	69	10			1
pH	68	7.4	8.4	6.4	4
	69	7.2	7.5	6.9	3
	70	6.9			1
Coliforms	68	5,000	7,700	3,500	2
	69	12,000	980,000	432	13
	70	3,900	4,400	24	4

TABLE 3.1 (continued)

Hiawatha Park
(RM 118.8)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved Oxygen	68	7.8	11.0	5.5	18
	69	8.9	11.0	5.8	12
	70	9.6	12.0	8.5	12
BOD	68	2.5	9.6	0.6	18
	69	1.3	2.5	0.6	11
	70	.9	2.5	.4	12
Phosphorus					
Total (as P)	68	0.04	0.09	0.01	18
	69	0.04	0.07	0.01	12
	70	0.03	0.12	0.01	12
Soluble (as P)	68	0.016	0.04	0.003	18
	69	0.01	0.04	0.0	11
	70	.01	.11	.0	12
Nitrogen					
NH ₃ (as N)	68	.08	.25	.01	18
	69	.11	.64	.01	9
	70	.11	.47	.06	12
NO ₂ (as N)	68	.0	.04	.0	18
	69	.0	.01	.0	12
	70	.0	.04	.0	12
NO ₃ (as N)	68	.08	.17	.01	18
	69	.06	.21	.00	11
	70	.09	.12	.07	12
Total Kjeldahl (as N)					
	68	.5	1.3	.07	18
	69	.57	1.5	.32	12
	70	.52	.98	.12	12
Hardness (as CaCO ₃)					
	68	31	36	26	7
	69	32	48	22	6
	70	28	28	28	3
Alkalinity (as CaCO ₃)					
	68	21	24	18	7
	69	23	34	15	6
	70	18	20	17	3
Total Iron (as Fe)					
	68	.60	1.06	.30	7
	69	.33	.45	.15	6
	70	.33	.50	.20	3
pH	68	7.4	8.3	7.1	7
	69	7.5	8.2	6.7	6
	70	7.3	7.3	7.3	3
Fluoride	68	.45	1.40	0.0	6
	69	.1	.3	0.0	6
	70	.1	.3	.1	12

TABLE 3.1 (continued)

Hiawatha Park (cont'd)
(RM 118.8)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total Solids	69	66	70	60	3
	70	71	110	45	11
Suspended Solids	69	5	5	5	3
	70	8	15	5	11
Turbidity (Jackson Units)	69	6	10	3	3
	70	5.3	10	6	11
Conductivity (micromhos)	69	73	87	68	3
	70	76	113	65	12
Chloride	69	3	3	2	3
	70	2	5	1	12
COD	69	45	80	24	3
	70	23	30	20	12
Coliforms	68	8,600	11,200	5,900	3
	69	3,000	120,000	156	11
	70	1,000	7,700	40	12

TABLE 3.1 (continued)

Channel S. Kettle Island
(RM 123.7)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved Oxygen	68	8.1	10	7	14
	69	8.3	10.5	5.0	9
	70	9.1	10	8	4
BOD	68	1.3	1.9	.7	14
	69	1.1	1.8	.5	9
	70	.8	1.2	.6	4
Phosphorus					
Total (as P)	68	.03	.1	.01	14
	69	.03	.04	.02	7
	70	.03	.04	.02	4
Soluble (as P)	68	.01	.02	.003	14
	69	.01	.02	.0	7
	70	.0	.0	.0	3
Nitrogen					
NH ₃ (as N)	68	.08	.19	.03	14
	69	.04	.13	.02	5
	70	.08	.09	.07	3
NO ₂ (as N)	68	.0	.02	.0	14
	69	.0	.01	.0	7
	70	.0			3
NO ₃ (as N)	68	.08	.18	.02	14
	69	.07	.18	.01	7
	70	.09	.11	.08	3
Total Kjeldahl (as N)					
	68	.41	.86	.27	14
	69	.52	1.1	.29	7
	70	.7	1.0	.49	4
Total Solids	68	65	69	58	2
	69	60			1
	70	62	90	40	4
Suspended Solids	68	3	3	2	2
	69	5			1
	70	8	15	5	4
Turbidity	68	6.5	6.5	6.5	2
	69	8.0			1
	70	6.8	8.0	4.5	3
Conductivity (micromhos)	68	80	80	80	2
	69	80			1
	70	64	79	53	4
Chloride	68	3	3	3	2
	69	3			1
	70	2	4	2	4
COD	68	0			2
	69	35			1
	70	21	30	15	4

TABLE 3.1 (continued)

Channel S. Kettle Island (cont'd)
(RM 123.7)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Hardness (as CaCO_3)	68				1
	69	30			1
	70	28			1
Alkalinity (as CaCO_3)	68				
	69	23			1
	70	17			1
Total Iron (as Fe)	69	.4			1
	70	.25			1
pH	69	7.7			1
	70	7.3			1
Sulphate	68	10			2
	69	14			1
	70	10	13	7	3
Coliforms	68	3,000	11,000	160	5
	69	700	3,300	180	8
	70	778	5,300	112	4

TABLE 3.1 (continued)

Alexandra Bridge Ottawa ✓
(RM 128.9)

Temp 805-1

Parameter	Year	Average	Maximum	Minimum	No. of Samples
0032 Dissolved Oxygen ✓	68	8.3	12.0	6.5	21
	69	9.7	13.0	5	25
	70	9.6	12.5	6.0	18
0013 BOD ✓	68	2.0	3.5	.7	21
	69	2.1	5.0	.4	24
	70	3.3	18.0	.6	18
0338 Phosphorus					
Total (as P) ✓	68	.025	.05	.01	21
	69	.02	.07	.01	21
	70	.02	.07	.01	18
0349 Soluble (as P) ✓	68	.01	.02	.003	21
	69	.01	.02	.0	18
	70	.01	.03	.0	18
0194 Nitrogen					
NH ₃ (as N) ✓	68	.08	.15	.03	21
	69	.05	.12	.01	21
	70	.46	2.3	.02	18
0215 NO ₂ (as N) ✓	68	.01	.02	.0	21
	69	.0	.01	.0	21
	70	.0	.01	.0	18
0226 NO ₃ (as N) ✓	68	.07	.15	.01	21
	69	.08	.17	.01	18
	70	.09	.11	.03	18
0207 Total Kjeldahl ✓					
(as N)	68	.43	1.2	.09	21
	69	.43	.64	.29	21
	70	.99	3.7	.34	18
00514 Total Solids ✓	69	74	95	40	11
	70	66	115	45	18
00615 Suspended Solids ✓	69	7	10	2	11
	70	7	15	5	18
01516 Turbidity					
(Jackson Units) ✓	69	9.1	15	4	9
	70	9.6	25	3	18
01418 Conductivity					
(micromhos)	69	88	103	78	11
	70	80	112	65	18
0569 Chloride	69	3	4	3	3
	70	2	6	2	18
04120 COD _X	69	34	62	22	8
	70	34	85	20	13

TABLE 3.1 (continued)

Alexandra Bridge Ottawa (cont'd)
(RM 128.9)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
076 22 Hardness (as CaCO ₃) ✓	69	25	34	22	11
	70	21	32	17	17
061 23 Total Iron ✓ (as Fe)	69	.38	.50	.30	5
	70	.42	.6	.2	10
055 10 pH ✓	69	7.6	8.0	7.3	11
	70	7.4	7.9	6.6	18
265 32 Arsenic	69	.015	.02	.01	2
225 28 Copper	69	.0			3
	70	.0	.02	.0	7
221 27 Chromium ✓	69	0			
060 24 Fluoride ✓	69	.0	.1	.0	3
	70	.1	.2	.1	5
059 25 Sulphate ✓	69	15.0	21.0	11.0	11
	70	12.0	20.0	9.0	18
229 24 Lead (as Pb)	69	0			2
249 31 Zinc (as Zn) ✓	69	.08	.2	.03	3
	70	.03	.05	.0	7
025 26 Phenol	70	7.5	15.0	.0	2
238 30 Nickel ✓ (as Ni)	70	.1			1
080 11 Coliforms ~	68	4,000	84,000	700	11
080 12	69	500	1,300	48	26
050 13	70	16,000	16,000	16	18

TABLE 3.1 (continued)

Britannia Water Works ✓
(RM 133.8)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved Oxygen ✓	68	8.9	11.5	7.0	7
	69	9.8	12.0	7.0	8
	70	10.1	12.0	8.0	8
✓ BOD ✓	68	.7	1.4	.5	7
	69	.8	1.6	.4	6
	70	1.2	2.5	.4	8
✓ Phosphorus					
Total (as P) ✓	68	.03	.04	.01	7
	69	.03	.05	.01	7
	70	.03	.08	.01	8
Soluble (as P) ✓	68	.01	.17	.007	7
	69	.01	.02	.0	6
	70	.01	.02	.0	7
✓ Nitrogen					
NH ₃ (as N) ✓	68	.06	.09	.02	7
	69	.04	.06	.02	7
	70	.08	.16	.03	7
NO ₂ (as N) ✓	68	.0	.01	.0	7
	69	.0	.02	.0	7
	70	.0	.01	.0	7
NO ₃ (as N) ✓	68	.08	.14	.01	7
	69	.12	.17	.0	7
	70	.0	.01	.0	7
✓ Total Kjeldahl ✓					
(as N)	68	.32	.52	.08	7
	69	.44	.72	.25	7
	70	.34	.76	.13	8
✓ Chloride ✓	68	3	4	2	6
	69	2	3	2	3
	70	5	7	3	7
✓ Total Solids ✓	68	77	90	58	6
	69	80	100	50	6
	70	85	100	60	8
✓ Suspended Solids ✓	68	8	28	3	6
	69	8	25	2	6
	70	5	5	5	8
✓ Turbidity					
(Jackson Units) ✓	68	5	7	3.1	5
	69	9	20	3	4
	70	8.4	25	1	8
✓ Conductivity ✓					
(micromhos)	68	92	115	80	5
	69	98	141	80	6
	70	108	132	83	8

TABLE 3.1 (continued)

Britannia Water Works (cont'd)
(RM 133.8)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Hardness					
(as CaCO_3) *	68	41	50	30	6
	69	47	76	32	5
	70	44	56	34	7
Alkalinity					
(as CaCO_3) *	68	32	88	16	6
	69	24	33	16	5
	70	24	33	17	7
Total Iron *					
(as Fe)	68	.31	.38	.25	6
	69	.37	.55	.30	5
	70	.31	.50	.10	7
pH *	68	7.6	8.3	6.9	6
	69	7.6	8.0	7.4	5
	70	7.3	8.0	6.8	7
Phenol *	68	5	15	0	6
	69	4.6	12	0	5
	70	3	12	0	7
Total Arsenic *	68	.0	.01	.0	6
	69	.02	.02	.02	3
	70	.0	.01	.0	4
COD *	68	24	49	11	6
	69	24	28	20	6
	70	20	24	12	8
Chromium					
(as Cr)	68	0			6
	69	0			5
	70	0			4
Copper					
(as Cu) *	68	.07	.07	.07	1
	69	.0			1
	70	.02	.07	.0	5
Cyanide	68	.01	.01	.0	6
	69	.0	.01	.0	4
	70	.0			5
Fluoride *	68	.1	.2	.0	5
	69	.1	.1	.0	4
	70	.4	1.1	.1	7
Sulphate *	68	17	27	13	6
	69	17	23	12	4
	70	18	26	10	7

TABLE 3.1 (continued)

Britannia Water Works (cont'd)
(RM 133.8)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Lead (as Pb)	68	.02	.04	0	5
	69	.0			4
	70	.04	.26	.0	7
Nickel (as Ni) x	69	0			1
	70	0			2
Coliforms ✓	68	54	4,000	40	4
	69	8	56	0	7
	70	8	180	4	7

TABLE 3.1 (continued)

Chats Falls (RM 163.6) ✓
(900')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved Oxygen	68	9.3	11.0	7.5	10
	69	10.1	12.5	8.0	9
	70	10.2	13.0	8.0	8
BOD	68	1.1	1.9	.6	10
	69	1.2	3.1	.4	9
	70	.7	1.4	.4	8
Phosphorus					
Total (as P)	68	.03	.08	.017	10
	69	.02	.03	.01	9
	70	.02	.04	.0	8
Soluble (as P)	68	.01	.03	.003	9
	69	.01	.02	.0	8
	70	.01	.02	.0	8
Nitrogen					
NH ₃ (as N)	68	.09	.14	.04	9
	69	.04	.09	.01	9
	70	.08	.11	.04	7
NO ₂ (as N)	68	.0	.01	.0	9
	69	.0	.01	.0	8
	70	.0	.01	.0	8
NO ₃ (as N)	68	.08	.13	.03	9
	69	.14	.22	.04	8
	70	.11	.16	.07	8
Total Kjeldahl (as N)	68	.34	.57	.12	9
	69	.37	.53	.15	9
	70	.48	.88	.22	8
Chloride	68	1	2	1	4
	69	2	3	2	3
	70	2	4	2	8
Phenol	68	12			1
Total Solids	68	79	122	59	4
	69	60	70	50	3
	70	65	80	50	8
Suspended Solids	68	6	15	2	4
	69	18	40	5	3
	70	5	10	5	8
Turbidity (Jackson Units)	68	6.6	8.0	5.0	4
	69	4.3	6.0	3.0	3
	70	6.8	12.0	3.0	8
Conductivity (micromhos)	68	75	77	74	4
	69	80	82	78	3
	70	81	126	65	8

TABLE 3.1 (continued)

Chats Falls (RM 163.6) (cont'd)
(900')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Hardness (as CaCO_3)	68	32	34	32	4
	69	30			1
	70	39	56	30	3
Alkalinity (as CaCO_3)	68	21	24	15	4
	69	21			1
	70	32	46	19	2
Total Iron (as Fe)	68	.50	.79	.23	4
	69	.35			1
	70	.45	.70	.25	3
pH	68	7.5	8.1	7.0	4
	69	7.9			1
	70	7.5	7.8	7.3	3
Sulphate	68	16			1
COD	69	22	24	19	3
	70	21	35	15	8
Coliforms	68	119	31,000	4	8
	69	325	1,700	16	8
	70	216	800	16	7

TABLE 3.1 (continued)

Chenau Dam (RM 188.6) ✓
(800')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved Oxygen	68	8.1	10	7	7
	69	9.8	11.5	6	8
	70	10.1	13	9	8
BOD	68	.8	1.7	.3	7
	69	1.3	2.0	.4	8
	70	.7	1.2	.4	8
Phosphorus					
Total (as P)	68	.013	.023	.003	7
	69	.03	.06	.01	8
	70	.02	.01	.01	8
Soluble (as P)	68	.007	.01	.003	7
	69	.01	.03	.0	8
	70	.01	.02	.0	8
Nitrogen					
NH ₃ (as N)	68	.07	.1	.02	7
	69	.03	.06	.01	8
	70	.06	.07	.05	8
NO ₂ (as N)	68	.0	.01	.0	7
	69	.0	.01	.0	7
	70	.0	.01	.0	8
NO ₃ (as N)	68	.09	.19	.02	7
	69	.15	.2	.09	7
	70	.12	.17	.07	8
Total Kjeldahl (as N)	68	.44	.91	.16	7
	69	.43	.8	.07	8
	70	.48	1.0	.2	8
Chloride	68				
	69	3	4	3	3
	70	2	3	2	8
Total Solids	68	56			1
	69	51	60	45	3
	70	61	70	50	7
Suspended Solids	68	2			1
	69	5	5	5	3
	70	5	10	5	7
Turbidity (Jackson Units)	69	5	6	3	3
	70	8.4	30	3	8
Conductivity (micromhos)	69	69	71	68	3
	70	67	75	56	8
Hardness (as CaCO ₃)	69	30			1
	70	32			3

TABLE 3.1 (continued)

Chenau Dam (RM 188.6) (cont'd)
(800')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Alkalinity (as CaCO ₃)	69	21			1
	70	21	21	20	2
Total Iron (as Fe)	69	.45			1
	70	.42	.60	.25	3
pH	69	7.7			1
	70	7.4	7.8	7.1	3
COD	69	26	30	23	3
	70	23	31	15	7
Sulphate	69	14	16	11	3
	70	11	15	9	7
Phenol	70	12	15	8	2
Cyanide	70	0			3
Lead (as Pb)	70	0			1
Coliforms	68	268	9,400	4	5
	69	188	1,800	68	8
	70	26	88	4	8

TABLE 3.1 (continued)

Des Joachims Dam (RM 282.0) ✓
(1000')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved Oxygen	68	8.1	9.5	7.0	6
	69	9.6	11.5	6.0	9
	70	10.3	11.0	9.0	8
BOD	68	.7	1.2	.3	7
	69	1.2	2.0	.4	9
	70	1.0	2.5	.4	8
Phosphorus					
Total (as P)	68	.02	.04	.007	7
	69	.02	.05	.01	9
	70	.03	.09	.01	8
Soluble (as P)	68	.007	.017	.003	7
	69	.01	.03	.0	9
	70	.01	.04	.0	8
Nitrogen					
NH ₃ (as N)	68	.07	.1	.04	7
	69	.07	.18	.03	9
	70	.09	.12	.07	8
NO ₂ (as N)	68	.0	.01	.0	7
	69	.0			9
	70	.0	.01	.0	8
NO ₃ (as N)	68	.09	.14	.05	7
	69	.12	.18	.06	9
	70	.1	.15	.05	8
Total Kjeldahl (as N)	68	.4	.74	.15	7
	69	.35	.74	.14	9
	70	.44	.71	.17	8
Chloride	69	2	3	2	3
	70	2	2	2	8
Total Solids	68	46			1
	69	55	60	45	3
	70	59	75	46	8
Suspended Solids	68	1			1
	69	5	5	5	3
	70	6	15	5	8
Turbidity (Jackson Units)	69	5.7	8	3	3
	70	7.3	15	3	8
Conductivity (micromhos)	69	72	76	68	3
	70	65	78	52	8

TABLE 3.1 (continued)

Des Joachims Dam (RM 282.0) (cont'd)
(1000')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Hardness					
(as CaCO_3)	69	31			1
	70	28	30	28	3
Alkalinity					
(as CaCO_3)	69	22			1
	70	18	21	16	3
Total Iron					
(as Fe)	69	.30			1
	70	.42	.45	.35	3
pH	69	7.4			1
	70	7.3	7.4	7.1	3
COD	69	28	35	24	3
	70	27	40	15	8
Phenol	70	5			1
Coliforms	68	600	11,200	4	5
	69	4	44	0	9
	70	4	500	4	8

TABLE 3.1 (continued)

Pembroke (RM 241.9)
(Center Main Channel)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved Oxygen	68	8.9	11.5	8.0	8
	69	9.9	17.0	8.0	10
	70	9.5	10.0	9.0	8
BOD	68	.8	1.7	.3	8
	69	1.1	.4	2.0	10
	70	1.8	8.0	.4	8
Phosphorus					
Total (as P)	68	.03	.06	.01	8
	69	.02	.05	.0	10
	70	.02	.04	.01	8
Soluble (as P)	68	.013	.04	.003	8
	69	.01	.02	.0	10
	70	.01	.03	.0	8
Nitrogen					
NH ₃ (as N)	68	.08	.16	.01	8
	69	.04	.08	.02	10
	70	.07	.10	.06	8
NO ₂ (as N)	68	.0	.01		8
	69	.0	.01	.0	9
	70	.01	.03	.0	8
NO ₃ (as N)	68	.12	.17	.03	8
	69	.13	.20	.05	9
	70	.12	.16	.07	8
Total Kjeldahl (as N)	68	.33	.94	.08	8
	69	.45	.68	.24	9
	70	.51	.89	.34	8
Chloride	69	2			3
	70	2	3	1	8
Total Solids	68	48			1
	69	50	60	30	3
	70	62	120	40	6
Suspended Solids	68	2			1
	69	11	25	5	3
	70	6	10	5	8
Turbidity (Jackson Units)	69	5.3	6	4	3
	70	6.3	20	3	8
Conductivity (micromhos)	69	68	71	66	
	70	96	177	58	8
Hardness (as CaCO ₃)	69	28			1
	70	29	30	28	3
Alkalinity (as CaCO ₃)	69	21			1
	70	16	21	9	3
Total Iron (as Fe)	69	.35			1
	70	.38	.50	.25	3

TABLE 3.1 (continued)

Pembroke (RM 241.9) (cont'd)
(Center Main Channel)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
pH	69	7.8			1
	70	7.4	7.9	7.2	4
COD	69	27	28	26	3
	70	22	35	15	7
Phenol	69	9			1
	70	10	25	0	8
Cyanide	69	0			1
	70	0			5
Sulphate	70	14			1
Lead					
(as Pb)	70	.07	.3	0	4
Coliforms	68	3,200	6,200	176	6
	69	965	3,900	20	10
	70	12	2,100	4	8

TABLE 3.1 (continued)

Deux Rivieres (RM 314.2)✓
(500')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved Oxygen	68	7.9	12.5	5	8
	69	9.5	12.5	5	6
	70	9.6	10	9	4
BOD	68	1.4	3.2	.6	8
	69	1.9	2.7	.6	6
	70	.8	1.8	.4	4
Phosphorus					
Total (as P)	68	.03	.04	.01	8
	69	.03	.07	.01	6
	70	.02	.01	.0	4
Phosphorus					
Soluble (as P)	68	.01	.03	.01	8
	69	.01	.02	.0	4
	70	.0			4
Nitrogen					
NH ₃ (as N)	68	.12	.13	.04	8
	69	.05	.07	.03	6
	70	.13	.18	.07	4
NO ₂ (as N)	68	.0	.02	.0	8
	69	.0			6
	70	.0	.01	.0	4
NO ₃ (as N)	68	.09	.13	.05	8
	69	.10	.18	.05	6
	70	.08	.11	.04	4
Total Kjeldahl					
(as N)	68	.38	.79	.09	8
	69	.42	.72	.25	6
	70	.56	.8	.36	4
Chloride	69	2			1
	70	2	4	1	4
Total Solids	68	62			1
	69	60			1
	70	62	75	50	4
Suspended Solids	68	5			1
	69	5			1
	70	7	10	5	4
Turbidity					
(Jackson Units)	69	6			1
	70	7.3	17	3	4
Conductivity	69	74			1
	70	65	67	59	4
Hardness					
(as CaCO ₃)	69	30			1
	70	4			1
Alkalinity					
(as CaCO ₃)	69	24			1
	70	20			1

TABLE 3.1 (continued)

Deux Rivieres (RM 314.2) (cont'd)
(500')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total Iron (as Fe)	69	.50			1
	70	.45			1
pH	69	7.3			1
	70	7.0			1
COD	69	41			1
	70	25	30	20	4
Coliforms	68	822	13,400	4	6
	69	10	56	4	6
	70	36	240	4	4

TABLE 3.1 (continued)

CPR Bridge Mattawa (RM 336.9)
(1200')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved Oxygen	68	9.8	12.5	8	8
	69	10.3	12.8	5	10
	70	10.1	12	8	8
BOD	68	1.3	1.8	.7	8
	69	1.3	3	.6	10
	70	1.7	3.5	.4	8
Phosphorus					
Total (as P)	68	.013	.02	.003	8
	69	.02	.05	.0	10
	70	.03	.14	.0	8
Soluble (as P)	68	.0067	.013	.003	8
	69	.01	.04	.0	8
	70	.0	.01	.0	8
Nitrogen					
NH ₃ (as N)	68	.06	.13	.02	8
	69	.05	.07	.02	10
	70	.12	.2	.03	8
NO ₂ (as N)	68	.0	.01	.0	8
	69	.0	.01	.0	10
	70	.0	.01	.0	8
NO ₃ (as N)	68	.08	.18	.01	8
	69	.15	.30	.02	10
	70	.09	.14	.06	8
Total Kjeldahl (as N)	68	.52	1.5	.11	8
	69	.39	.64	.16	10
	70	.49	1.1	.12	8
Chloride	69	3	4	2	3
	70	2	3	2	8
Total Solids	68	56			1
	69	51	60	45	3
	70	64	85	45	8
Suspended Solids	68	4			1
	69	5			3
	70	9	25	5	8
Turbidity (Jackson Units)	69	8.0	10	6	3
	70	6.6	10	3	8
Conductivity (micromhos)	69	72	75	68	3
	70	66	72	62	8
Hardness (as CaCO ₃)	69	33			1
	70	26	30	24	3

TABLE 3.1 (continued)

CPR Bridge Mattawa (RM 336.9) (cont'd)
(1200')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Alkalinity (as CaCO ₃)	69	25	19	16	3
	70	17	19	16	3
Total Iron (as Fe)	69	.5			1
	70	.37	.45	.25	3
pH	69	7.3			1
	70	7.4	7.6	7.0	3
COD	69	32	40	24	3
	70	27	39	15	8
Phenol	70	2	2	2	1
Coliforms	68	4,750	28,000	4	6
	69	69	308	4	10
	70	4	116	4	8

TABLE 3.1 (continued)

Otto Holden Dam (RM 340.9) /
(1200')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved Oxygen	68	8.1	9	7	6
	69	9.4	13	4.8	9
	70	9.7	10.5	9	8
BOD	68	1.1	1.6	.4	6
	69	2.2	3.5	1.0	9
	70	1.7	3.5	.8	8
Phosphorus					
Total (as P)	68	.016	.023	.007	6
	69	.03	.08	.02	9
	70	.03	.08	.01	8
Soluble (as P)	68	.007	.013	.003	6
	69	.01	.06	.0	8
	70	.02	.00	.0	8
Nitrogen					
NH ₃ (as N)	68	.07	.2	.01	6
	69	.06	.17	.01	9
	70	.17	.24	.02	8
NO ₂ (as N)	68	.01	.02	.0	6
	69	.0			9
	70	.0	.01	.0	8
NO ₃ (as N)	68	.08	.13	.01	6
	69	.15	.27	.02	9
	70	.09	.15	.04	8
Total Kjeldahl (as N)	68	.34	.82	.08	6
	69	.56	1.3	.29	9
	70	.6	1.2	.32	8
Chloride	69	2	3	2	3
	70	2	3	1	8
Total Solids	68	74			1
	69	60	70	50	4
	70	63	80	50	8
Suspended Solids	68	4			1
	69	5	5	5	4
	70	8	15	5	8
Turbidity (Jackson Units)	69	10.8	25	4	4
	70	5	10	3	8
Conductivity (micromhos)	69	74	78	68	3
	70	94	286	58	8
Hardness (as CaCO ₃)	69	33			1
	70	32	36	26	3
Alkalinity (as CaCO ₃)	69	25			1
	70	20	24	15	3

TABLE 3.1 (continued)

Otto Holden Dam (RM 340.9) (cont'd)
(1200')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total Iron (as Fe)	69	.40			1
	70	.37	.40	.30	3
pH	69	7.3			1
	70	7.4	7.7	7.0	3
COD	69	34	40	30	3
	70	27	39	15	8
Phenol	70	5			
Copper (as Cu)	70	0			
Fluoride	70	.1			
Sulphate	70	10			
Zinc (as Zn)	70	.04			
Coliforms	68	10,900	57,000	32	4
	69	20	116	4	9
	70	8	168	4	8

TABLE 3.1 (continued)

Timiskaming Dam (RM 372.4) ✓
(200')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total Solids	68	72			1
	69	53	60	50	3
	70	51	65	45	6
Suspended Solids	68	2			1
	69	5	5	5	3
	70	5	5	5	6
Chloride	69	2	4	2	3
	70	2	4	1	6
Hardness (as CaCO ₃)	69	34	40	32	3
	70	27	34	24	5
Alkalinity (as CaCO ₃)	69	26	32	22	3
	70	17	20	15	4
Total Iron (as Fe)	69	.55	.60	.50	3
	70	.51	.80	.40	5
pH	69	7.4	7.6	7.2	3
	70	7.7	8.0	7.4	5
COD	69	19	23	15	3
	70	22	30	15	6
Lead (as Pb)	69	.01	.04	.0	3
	70	.0			5
Phenol	69	0			1
	70	4	12	.0	5
Chromium (as Cr)	70	0.01	0.02	.0	2
Cyanide	70	0			1
Fluoride	69	.1	.1	.0	3
	70	.1	.3	.0	5
Conductivity (micromhos)	70	65	78	60	6
Turbidity (Jackson Units)	70	6.4	10	4	5
Arsenic	70	0			1
Total Kjeldahl (as N)	68	.3	.71	.1	8
	69	.41	1.7	.08	10
	70	.4	.64	.24	5
Total Solids	69	135	200	20	2
Suspended Solids	69	3	5	1	2
Turbidity (Jackson Units)	69	8.5			1
Conductivity (micromhos)	69	188	300	72	2
Chloride	69	2			2

TABLE 3.1 (continued)

Timiskaming Dam (RM 372.4) (cont'd)
(Composite)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Hardness (as CaCO ₃)	69	32	33	32	2
Alkalinity (as CaCO ₃)	69	19	20	19	2
Total Iron (as Fe)	69	.40	.50	.30	2
pH	69	7.7	8.2	7.2	2
Phenol	69	6	8	3	2
COD	69	39	55	23	2
Chromium (as Cr)	69	.03	.07	.0	2
Cyanide	69	0			1
Fluoride	69	.1	.2	.0	2
Sulphate	69	15	18	11	12
Lead (as Pb)	69	0			1
(600')					
Dissolved Oxygen	68	9.6	11.5	8.5	8
	69	11.4	12.6	9.2	7
	70	8.0	8.0	8.0	2
BOD ✓	68	.7	1.5	.3	7
	69	.7	1.0	.4	7
	70	.4	.4	.4	2
Phosphorus					
Total (as P) ✓	68	.017	.04	.067	7
	69	.03	.11	.01	6
	70	.01	.02	.01	2
Soluble (as P) ✓	68	.01	.017	.0067	7
	69	.0	.01	.0	5
	70	.0	.01	.0	2
Nitrogen					
NH ₃ (as N) ✓	68	.07	.12	.01	7
	69	.06	.19	.01	7
	70	.09	.12	.06	2
NO ₂ (as N) ✓	68	.0	.02	.0	7
	69	.0	.01	.0	7
	70	.0	.01	.0	2
NO ₃ (as N) ✓	68	.12	.18	.08	7
	69	.16	.33	.08	7
	70	.1	.12	.09	2
Total Kjeldahl ✓ (as N)	68	.28	.72	0.00	8
	69	.35	.5	.16	7
	70	.43	.48	.39	2
Chloride ✓	70	2			2

TABLE 3.1 (continued)

Timiskaming Dam (RM 372.4) (cont'd)
(600')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total Solids ✓	68	20			1
	70	75	80	70	2
Suspended Solids ✓	70	10	15	5	2
Turbidity ✓ (Jackson Units)	69	8.5			1
	70	5.0	6.0	4.0	2
Conductivity ✓ (micromhos)	69	76			1
	70	66	67	65	2
Hardness (as CaCO ₃) ✓	69	32			2
	70	34			1
Alkalinity (as CaCO ₃) ✓	69	19			2
	70	21			1
Total Iron ✓ (as Fe)	69	.40			1
	70	.45			1
pH ✓	69	7.7			2
	70	7.2			1
Phenol	70	3			1
Arsenic ✓	70	0			1
COD	70	13	15	10	2
Cyanide ✓	70	0			1
Fluoride	70	0.3			1
Lead ✓ (as Pb)	70	.15	.3	0	2
Coliforms	68	118	6,600	4	6
	69	24	900	4	6
	70	4,520	9,000	40	2

TABLE 3.2
WATER QUALITY MONITORING DATA
MAJOR TRIBUTARIES TO THE
OTTAWA RIVER

Note:

All results are averages reported in mg/l, except for pH (standard pH units), coliforms (median, total number per 100 ml), turbidity (standard Jackson units), and phenol ($\mu\text{g/l}$).

TABLE 3.2
MONITORING DATA
MAJOR TRIBUTARIES OF THE OTTAWA RIVER

Rouge River (RM 73.2)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Coliforms	68	1,500	30,000	672	5
	69	288	2,900	144	7
	70	144	330	4	9
BOD	68	1.6	3.4	0.6	8
	69	0.8	1.5	0.2	8
	70	1.2	2.5	0.6	8
Total Phosphorus	68	.02	.04	.01	8
	69	.03	.05	0.00	8
	70	.01	.02	.01	7
Soluble Phosphorus	68	.01	.01	0.00	8
	69	.01	.02	0.00	4
	70	0.00	.02	0.00	8
Total Kjeldahl	68	.59	1.6	.10	8
	69	.45	.72	.16	8
	70	.24	.54	.13	7
Free NH ₃	68	.07	.20	.03	8
	69	.05	.11	.01	8
	70	.05	.09	.03	8
NO ₂	68	0.00	.01	0.00	8
	69	0.00	0.00	0.00	7
	70	0.00	.01	0.00	8
NO ₃	68	.09	.16	.03	8
	69	.12	.20	.03	7
	70	.12	.28	.01	8
Dissolved Oxygen	68	9.0	10.5	7.0	8
	69	11.4	13.0	9.0	7
	70	10.4	13.0	5.0	7
Total Solids	69	61	80	50	3
	70	71	140	40	8
Turbidity	69	6	8	2	3
	70	8	30	2	8
Conductivity	69	49	54	42	3
	70	72	154	47	8
Chlorides	69	3	4	3	3
	70	3	5	2	7
Hardness	69	22	22	22	1
	70	22	28	16	3
Alkalinity	69	19	19	19	1
	70	14	17	12	3

TABLE 3.2 (continued)

Rouge River (RM 73.2) (cont'd)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total Iron	69	.55	.55	.55	1
	70	.80	1.75	.25	3
pH	69	7.9	7.9	7.9	1
	70	7.5	7.6	7.4	3
COD	69	32	41	16	3
	70	17	20	10	6
Sulphate	70	7	7	7	1

TABLE 3.2 (continued)

South Nation River (RM 95.0)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Coliforms	68	2,100	45,000	108	5
	69	1,325	2,600	100	6
	70	146	400	60	8
BOD	68	2.6	3.4	1.8	7
	69	66.8	450	1.4	7
	70	2.2	4.0	1.2	7
Total Phosphorus	68	.20	.40	.09	7
	69	.13	.19	.08	7
	70	.15	.05	.26	7
Soluble Phosphorus	68	.10	.15	.03	7
	69	.07	.13	.02	5
	70	.08	.11	.02	7
Total Kjeldahl	68	1.17	1.92	.52	7
	69	1.43	2.9	.80	6
	70	.97	1.5	.66	7
Free NH ₃	68	.20	.40	.05	7
	69	.10	.24	.01	7
	70	.15	.28	.05	7
NO ₂	68	.01	.03	.01	7
	69	.06	.34	0.00	6
	70	.01	.03	0.00	7
NO ₃	68	.07	.17	.01	7
	69	.19	.51	0.00	6
	70	.17	.33	.01	5
Dissolved Oxygen	68	7.2	9.0	5.0	6
	69	8.2	10.0	6.0	7
	70	8.1	10.0	6.5	6
Total Solids	69	258	295	220	3
	70	272	360	80	7
Suspended Solids	69	31	35	30	3
	70	19	80	5	7
Turbidity	69	35	50	20	3
	70	22	70	8	7
Conductivity	69	362	447	290	3
	70	378	525	112	7
Chlorides	69	22	34	14	3
	70	18	28	5	7
Hardness	69	141	168	114	2
	70	146	206	48	5
Alkalinity	69	130	168	97	3
	70	131	185	30	6
Total Iron	69	1.2	1.2	1.2	1
	70	1.71	4.8	.25	4
pH	69	7.8	8.0	7.5	3
	70	7.8	8.3	7.4	6
Phenol	70	5	5	5	1

TABLE 3.2 (continued)

South Nation River (RM 95.0) (cont'd)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
COD	69	165	384	40	3
	70	34	48	30	7
Total Copper	69	0.00	0.00	0.00	1
	70	0.00	0.00	0.00	7
Total Fluoride	69	.1	.1	.1	1
	70	.1	.1	.1	3
Sulphate	69	32	35	26	3
	70	25	46	14	6
Zinc	69	.07	.07	.07	1
	70	.03	.06	0.00	3
Total Nickel	70	0.00	0.00	0.00	1

TABLE 3.2 (continued)

Lievre River (RM 113.3)
(50')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Coliforms	68	1,500	3,100	776	4
	69	533	10,700	240	4
BOD	68	1.1	2.8	0.4	8
	69	0.8	1.4	.4	5
Total Phosphorus	68	.10	.22	.05	8
	69	.08	.11	.02	5
Soluble Phosphorus	68	.05	.08	.03	8
	69	.05	.07	0.00	5
Total Kjeldahl	68	.39	.74	.15	8
	69	.28	.48	.10	5
Free NH ₃	68	.06	.09	.04	8
	69	.05	.09	.02	5
NO ₂	68	0.00	.01	0.00	8
	69	0.00	0.00	0.00	5
NO ₃	68	.06	.14	.01	8
	69	.09	.18	.03	4
Dissolved Oxygen	68	8.7	11.0	7.5	7
	69	10.5	12.0	7.2	5

(100')

Coliforms	68	3,400	3,800	676	5
	69	1,185	10,400	256	6
	70	232	900	4	7
BOD	68	1.1	2.0	0.4	8
	69	1.0	2.0	0.3	8
	70	1.2	2.0	0.4	7
Total Phosphorus	68	.10	.23	.02	8
	69	.10	.17	.02	8
	70	.07	.15	.03	7
Soluble Phosphorus	68	.06	.10	.03	8
	69	.07	.13	0.00	8
	70	.04	.06	.01	6
Total Kjeldahl	68	.37	.58	.19	8
	69	.38	.66	.06	8
	70	1.12	6.0	.05	7
Free NH ₃	68	.05	.08	.01	8
	69	.05	.13	.01	8
	70	.05	.15	.01	6
NO ₂	68	0.00	.01	0.00	8
	69	0.00	0.00	0.00	8
	70	0.00	0.00	0.00	6
NO ₃	68	.06	.12	.01	8
	69	.09	.17	.03	7
	70	.15	.23	.07	6

TABLE 3.2 (continued)

Lievre River (RM 113.3) (cont'd)
(100')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Dissolved oxygen	68	8.9	11.0	7.0	8
	69	9.6	11.5	7.2	8
	70	10.9	13.0	6.0	7
Total Solids	69	45	65	30	3
	70	49	55	45	5
Suspended Solids	69	8	15	5	3
	70	7	20	5	7
Turbidity	69	7	10	3	3
	70	9.4	40	1.5	7
Conductivity	69	55	57	54	3
	70	59	72	46	7
Chlorides	69	2	3	2	3
	70	2	3	2	6
Hardness	69	23	24	23	2
	70	28	48	18	5
Alkalinity	69	19	21	17	3
	70	16	21	14	5
Total Iron	69	.35	.35	.35	2
	70	.54	1.25	.25	6
pH	69	7.5	7.6	7.5	3
	70	7.3	7.8	6.9	6
Phenol	70	7	7	7	1
COD	69	34	46	16	3
	70	23	68	7	7
Total Fluoride	69	0.0	0.0	0.1	3
	70	.1	.2	0.0	6

(150')

Coliforms	68	4,700	10,000	710	5
	69	558	5,300	192	4
BOD	68	1.2	3.0	0.3	8
	69	1.0	1.6	0.3	5
Total Phosphorus	68	.11	.23	.05	8
	69	.08	.11	.02	5
Soluble Phosphorus	68	.07	.12	.03	8
	69	.05	.08	0.00	5
Total Kjeldahl	68	.41	.64	.09	8
	69	.29	.58	.14	5
Free NH ₃	68	.05	.10	.01	8
	69	.05	.13	.02	5
NO ₂	68	0.00	.01	0.00	8
	69	0.00	.01	0.00	5
NO ₃	68	.06	.11	.01	8
	69	.09	.18	.03	4
Dissolved Oxygen	68	8.8	12.0	7.5	8
	69	10.2	11.5	7.2	5

TABLE 3.2 (continued)

Gatineau River (RM 127.3)
(175')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Coliforms	69	550	7,700	124	8
	70	300	5,300	216	7
BOD	69	1.0	2.7	0.4	8
	70	1.3	3.0	0.4	7
Total Phosphorus	69	.03	.11	.02	8
	70	.02	.05	.01	7
Soluble Phosphorus	69	.01	.02	0.00	6
	70	.01	.02	0.00	7
Total Kjeldahl	69	.35	.70	.22	8
	70	.49	.76	.24	7
Free NH ₃	69	.07	.16	.01	8
	70	.05	.09	.02	7
NO ₂	69	0.00	0.00	0.00	8
	70	0.00	0.00	0.00	7
NO ₃	69	.08	.14	.01	8
	70	.09	.18	.03	7
Dissolved Oxygen	69	10.7	12.5	7.0	8
	70	10.4	13.0	8.0	7
Total Solids	69	60	70	50	2
	70	48	65	35	7
Suspended Solids	69	7	10	5	2
	70	7	15	5	7
Turbidity	69	8	8	8	2
	70	8	25	2	7
Conductivity	69	48	56	41	3
	70	55	76	41	7
Chlorides	69	1	2	1	3
	70	2	4	1	7
Hardness	69	20	26	14	2
	70	23	26	20	3
Alkalinity	70	17	21	14	3
Total Iron	69	.35	.35	.35	1
	70	.68	1.1	.45	3
pH	69	7.8	7.8	7.8	1
	70	7.8	8.4	7.2	3
COD	69	24	28	20	3
	70	21	40	15	7

(350')

Coliforms	69	108	316	72	4
BOD	69	1.7	2.8	0.6	4
Total Phosphorus	69	.03	.04	.02	4
Soluble Phosphorus	69	.01	.01	.01	1

TABLE 3.2 (continued)

Gatineau River (RM 1273.) (cont'd)
(350')

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total Kjeldahl	69	.39	.66	.21	4
Free NH ₃	69	.04	.05	.02	3
NO ₂	69	0.00	0.00	0.00	3
NO ₃	69	.05	.10	.01	2
Dissolved Oxygen	69	11.8	12.5	10.5	4

TABLE 3.2 (continued)

Rideau River (East) (RM 128.1)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Coliforms	68	600	6,400	12	13
	69	198	2,200	8	10
	70	44	3,400	4	10
BOD	68	2.3	5.6	0.5	16
	69	3.2	19.1	1.0	12
	70	1.5	3.5	0.4	10
Total Phosphorus	68	.10	.29	.04	16
	69	.07	.16	.03	12
	70	.07	.12	.04	10
Soluble Phosphorus	68	.06	.16	0.00	15
	69	.02	.04	0.00	11
	70	.03	.05	.01	10
Total Kjeldahl	68	1.14	3.8	.62	15
	69	.69	.9	.26	12
	70	1.0	2.6	.47	10
Free NH ₃	68	.22	.66	.03	15
	69	.08	.22	.02	11
	70	.15	.29	.03	10
NO ₂	68	.01	.04	0.00	15
	69	.01	.02	0.00	12
	70	0.00	.01	0.00	10
NO ₃	68	.16	.38	.06	15
	69	.11	.30	.01	11
	70	.15	.22	.07	7
Dissolved Oxygen	68	9.3	13.0	6.0	16
	69	6.8	10.0	4.0	12
	70	6.4	8.0	4.0	11
Total Solids	68	330	1,150	156	9
	69	211	330	160	12
	70	213	305	160	10
Suspended Solids	68	13	67	1	9
	69	12	40	5	12
	70	7	10	5	10
Turbidity	68	9.7	45	2.3	9
	69	5.2	9	2	12
	70	5.2	15	2	10
Conductivity	68	462	1,534	260	9
	69	306	410	229	12
	70	319	495	200	10
Chloride	68	22	123	7	9
	69	10	21	5	12
	70	12	37	8	10
Hardness	68	162	204	138	7
	69	159	218	120	10
	70	161	224	112	7

TABLE 3.2 (continued)

Rideau River (East) (cont'd)
(RM 128.1)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Alkalinity	68	132	164	111	7
	69	137	188	104	11
	70	135	191	76	8
Total Iron	68	.63	2.25	.13	7
	69	.68	4.2	.15	10
	70	.37	1.05	0.00	7
pH	68	7.9	8.2	7.4	7
	69	8.1	8.4	7.7	10
	70	8.1	8.3	7.8	8
Phenol	68	6	8	4	2

TABLE 3.2 (continued)

Rideau River (West) (RM 128.1)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Coliforms	68	960	3,200	156	8
	69	346	4,200	40	10
	70	30	388	4	10
BOD	68	2.3	8.8	0.4	8
	69	1.5	3.0	0.5	12
	70	1.7	3.5	0.4	10
Total Phosphorus	68	.12	.28	.04	8
	69	.08	.33	.03	12
	70	.08	.14	.04	10
Soluble Phosphorus	68	.06	.12	.02	7
	69	.03	.01	.05	9
	70	.03	.06	0.00	10
Total Kjeldahl	68	1.25	2.4	.71	7
	69	.70	.9	.52	12
	70	.98	1.6	.68	10
Free NH ₃	68	.30	.72	.08	7
	69	.09	.22	.01	11
	70	.16	.31	.04	10
NO ₂	68	.02	.06	0.00	7
	69	0.00	.02	0.00	12
	70	0.00	.01	0.00	10
NO ₃	68	.25	.50	.10	7
	69	.09	.24	.01	11
	70	.14	.23	.01	7
Dissolved Oxygen	68	10.0	11.0	8.0	8
	69	6.8	11.0	3.0	12
	70	5.5	9.0	3.0	11
Total Solids	68	320	844	150	7
	69	206	280	160	12
	70	208	270	150	10
Suspended Solids	68	12	36	1	7
	69	6	10	5	12
	70	11	40	5	10
Turbidity	68	9.6	23	2.9	7
	69	3.9	6	1	12
	70	4.3	8	2	10
Conductivity	68	459	1,190	273	7
	69	302	412	229	12
	70	323	445	244	10
Chlorides	68	28	115	8	7
	69	8	23	5	12
	70	11	25	8	10
Hardness	68	154	198	124	5
	69	156	216	120	10
	70	157	222	112	8
Alkalinity	68	124	153	99	5
	69	136	187	103	11
	70	138	190	102	8

TABLE 3.2 (continued)

Rideau River (West) (cont'd)
(RM 128.1)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total Iron	68	.44	1.18	.21	5
	69	.35	.75	.15	10
	70	.36	1.0	0.00	7
pH	68	7.7	8.1	7.3	5
	69	8.1	8.6	7.5	10
	70	8.1	8.6	7.8	8
Phenol	68	20	30	10	2

TABLE 3.2 (continued)

Mississippi River (RM 165.3)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Coliforms	68	590	57,000	20	11
	69	436	2,800	20	7
	70	96	1,500	4	8
BOD	68	1.4	2.7	0.6	13
	69	1.1	2.7	0.4	8
	70	1.1	2.0	0.6	8
Total Phosphorus	68	.05	.10	.02	13
	69	.03	.06	.01	8
	70	.05	.16	.01	8
Soluble Phosphorus	68	.02	.06	0.00	13
	69	.01	.03	0.00	7
	70	.01	.05	0.00	8
Total Kjeldahl	68	.66	.90	.39	13
	69	.61	.98	.22	8
	70	.71	1.4	.41	8
Free NH ₃	68	.14	.39	.01	13
	69	.07	.11	.04	8
	70	.08	.13	.06	7
NO ₂	68	0.00	.01	0.00	13
	69	0.00	.01	0.00	7
	70	.01	.03	0.00	8
NO ₃	68	.09	.30	0.00	13
	69	.09	.20	0.00	7
	70	.09	.27	.01	7
Dissolved Oxygen	68	9.2	12.5	4.0	14
	69	10.8	12.5	8.0	8
	70	9.7	11.5	8.0	9
Total Solids	68	158	176	146	7
	69	153	170	140	3
	70	150	180	120	8
Suspended Solids	68	10	28	1	7
	69	8	10	5	3
	70	14	75	5	8
Turbidity	68	7.9	26	3.1	6
	69	8.0	12	6	3
	70	8.8	40	1.5	8
Conductivity	68	206	238	120	6
	69	219	230	205	3
	70	217	263	186	8
Chloride	68	5	7	4	6
	69	6	8	4	3
	70	4	6	2	8
Hardness	68	113	126	88	4
	69	109	118	103	3
	70	103	128	60	6

TABLE 3.2 (continued)

Mississippi River (RM 165.3) (cont'd)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Alkalinity	68	99	110	78	4
	69	97	99	95	3
	70	88	111	42	7
Total Iron	68	.65	1.4	.29	4
	69	.35	.35	.35	1
	70	.71	2.3	.15	4
pH	68	7.7	7.9	7.5	4
	69	7.4	8.3	5.8	3
	70	8.1	8.4	7.9	7
Phenol	70	4	8	0	2
COD	69	25	26	24	2
	70	22	31	15	8
Total Copper	69	0.00	0.00	0.00	1
	70	0.00	0.00	0.00	3
Total Fluoride	69	0.1	0.1	0.1	1
	70	0.2	0.2	0.1	3
Sulphate	69	13	15	10	3
	70	12	15	7	7
Total Nickel	70	.05	.05	.05	1
Total Zinc	69	.04	.04	.04	1
	70	.03	.08	0.00	3

TABLE 3.2 (continued)

Madawaska River (RM 169.4)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Coliforms	68	84	5,400	4	9
	69	72	1,100	8	7
	70	38	700	4	8
BOD	68	1.5	3.7	.5	13
	69	1.7	3.4	.4	7
	70	1.0	3.0	0.4	8
Total Phosphorus	68	.03	.07	.01	13
	69	.02	.03	0.00	7
	70	.04	.08	.01	8
Soluble Phosphorus	68	.01	.02	0.00	13
	69	.01	.02	0.00	7
	70	.01	.05	0.00	8
Total Kjeldahl	68	.68	2.2	.30	13
	69	.40	.62	.11	8
	70	.45	.84	.15	8
Free NH ₃	68	.11	.20	.03	13
	69	.05	.08	.02	8
	70	.06	.11	.02	8
NO ₂	68	0.00	0.01	0.00	13
	69	0.00	0.00	0.00	7
	70	.01	.02	0.00	8
NO ₃	68	.37	4.0	0.00	13
	69	.09	.20	.01	7
	70	.08	.18	.01	8
Dissolved Oxygen	68	10.2	13.0	8.0	14
	69	11.4	13.5	9.0	8
	70	9.8	12.0	9.0	8
Total Solids	68	84	99	44	6
	69	95	105	80	3
	70	103	185	65	8
Suspended Solids	68	8	15	2	6
	69	8	15	5	3
	70	10	45	5	8
Turbidity	68	4.9	8.5	3.5	5
	69	8.0	12	6	3
	70	10.3	40	3	8
Conductivity	68	131	230	97	5
	69	112	114	111	3
	70	131	332	51	8
Chloride	68	2	3	2	5
	69	3	3	3	3
	70	3	6	2	8
Hardness	68	54	60	50	3
	69	55	60	52	3
	70	55	118	24	7

TABLE 3.2 (continued)

Madawaska River (cont'd)
(RM 169.4)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Alkalinity	68	43	49	38	3
	69	45	48	42	3
	70	44	100	16	7
Total Iron	68	.49	.72	.37	3
	69	.65	.65	.65	1
	70	.86	2.8	.25	5
pH	68	7.6	7.7	7.5	3
	69	7.8	8.2	7.5	3
	70	7.9	8.1	7.5	7
Phenol	70	6	12	0	2
COD	69	21	24	18	2
	70	18	25	10	7
Total Copper	69	0.00	0.00	0.00	1
	70	0.00	0.00	0.00	3
Total Fluoride	69	0.1	0.1	0.1	1
	70	0.1	0.2	0.1	4
Sulphate	69	12	14	10	3
	70	11	16	7	8
Total Nickel	70	0.05	0.05	0.05	1
Total Zinc	69	.04	.04	.04	1
	70	.05	.11	0.00	3

TABLE 3.2 (continued)

Petawawa River (RM 251.7)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Coliforms	68	1,600	10,000	4	5
	69	40	140	0	8
	70	24	700	4	8
BOD	68	1.0	3.2	0.5	8
	69	1.8	3.1	0.6	8
	70	1.1	2.0	0.6	7
Total Phosphorus	68	.03	.12	0.00	8
	69	.03	.09	.01	7
	70	.01	.01	0.00	7
Soluble Phosphorus	68	.02	.08	0.00	8
	69	.01	.03	0.00	6
	70	0.00	0.01	0.00	7
Total Kjeldahl	68	.47	1.46	.10	8
	69	.34	.54	.12	8
	70	.38	.58	.26	7
Free NH ₃	68	.06	.15	.01	8
	69	.03	.06	.01	8
	70	.06	.12	.01	7
NO ₂	68	0.00	0.00	0.00	8
	69	0.00	.01	0.00	8
	70	0.00	.01	0.00	7
NO ₃	68	.02	.04	.01	8
	69	.08	.16	.01	8
	70	.08	.11	.04	6
Dissolved Oxygen	68	8.1	11.0	6.0	6
	69	11.1	12.5	8.0	8
	70	10.8	12.0	10.0	7
Total Solids	68	36	36	36	1
	69	53	60	40	3
	70	45	50	40	7
Suspended Solids	68	2	2	2	1
	69	8	15	5	3
	70	5	10	5	7
Turbidity	69	4.3	6	2	3
	70	3.1	6	1.5	7
Conductivity	69	53	61	48	3
	70	50	61	45	7
Chloride	69	1	2	1	3
	70	1	3	1	7
Hardness	69	20	22	18	3
	70	55	192	16	5
Alkalinity	69	12	13	11	3
	70	11	14	9	6

TABLE 3.2 (continued)

Petawawa River (cont'd)
(RM 251.7)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Total Iron	69	.27	.30	.25	2
	70	.20	.21	.20	4
pH	69	7.6	8.0	7.3	3
	70	7.6	8.2	7.2	6
Phenol	69	0	0	0	1
	70	0	0	0	1
COD	69	14	14	14	1
	70	27	80	10	6
Total Copper	69	0.00	0.00	0.00	1
	70	0.00	0.00	0.00	3
Total Fluoride	69	0.1	0.1	0.1	1
	70	0.0	0.2	0.0	3
Sulphate	69	8	11	7	3
	70	9	10	7	7
Total Zinc	69	.05	.05	.05	1
	70	.04	.06	.02	3

TABLE 3.2 (continued)

Mattawa River (RM 336.7)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
Coliforms	68	15,200	40,000	20	6
	69	118	388	24	8
	70	16	220	4	7
BOD	68	1.1	1.9	0.5	8
	69	1.4	2.8	0.5	9
	70	1.0	2.5	0.4	7
Total Phosphorus	68	.03	.07	.01	8
	69	.02	.04	.01	9
	70	.02	.04	.01	7
Soluble Phosphorus	68	.013	.05	.003	8
	69	.01	.02	0.00	7
	70	0.00	.01	0.00	7
Total Kjeldahl	68	.35	.53	.17	8
	69	.33	.46	.10	9
	70	.47	.70	.32	7
Free NH ₃	68	.06	.11	.01	8
	69	.04	.07	.01	9
	70	.06	.15	.01	7
NO ₂	68	0.00	.01	0.00	8
	69	0.00	0.00	0.00	9
	70	0.00	.01	0.00	7
NO ₃	68	.09	.16	.01	8
	69	.11	.18	.03	9
	70	.10	.21	.02	7
Dissolved Oxygen	68	9.4	12.0	8.0	8
	69	10.1	12.5	6.0	9
	70	9.0	11.0	7.0	6
Total Solids	68	64	64	64	1
	69	50	65	40	3
	70	54	60	45	7
Suspended Solids	68	4	4	4	1
	69	5	5	5	3
	70	5	5	5	7
Turbidity	69	6.0	8	4	3
	70	4.4	8	2	7
Conductivity	69	70	80	57	3
	70	58	66	49	7
Chloride	69	4	7	2	3
	70	2	3	2	7
Hardness	69	31	31	31	1
	70	22	22	22	2
Alkalinity	69	23	23	23	1
	70	12	14	11	2
Total Iron	69	.45	.45	.45	1
	70	.17	.20	.15	2

TABLE 3.2 (continued)

Mattawa River (cont'd)
(RM 336.7)

Parameter	Year	Average	Maximum	Minimum	No. of Samples
pH	69	7.3	7.3	7.3	1
	70	7.5	7.9	7.2	2
COD	69	21	24	18	2
	70	21	32	15	7



CHAPTER 4

MODELLING THE BOD/DO RELATIONSHIP IN THE OTTAWA RIVER

4.1 MODELLING CONSIDERATION

A river is a complex system composed of interacting physical, chemical and biological forces. The overall system or any of the sub-systems making up the whole, respond to changes in waste input, hydrodynamic and physical conditions. Some of these changes, such as streamflow, are readily observable and are comparatively easy to predict. Other factors such as the oxygen demand of bottom deposits, are just as significant but are much more difficult to measure.

The purpose of a model, either physical or mathematical is to reproduce forces within the system, and, once verified, to predict changes in water quality conditions for any combination of alterations to the various forcing functions mentioned above.

A model of the several forces occurring in a watercourse provides an extremely useful tool for solving immediate pollution problems and for assisting in long-term planning of water use and development within a river basin.

In the Ottawa River Basin, pulp and paper mills and, to a much lesser extent, municipal sewage treatment plants discharge oxygen-consuming waste products to the system and these materials significantly deplete the dissolved oxygen resources of the river for many miles below the waste sources. In an effort to determine the organic loading limits that should be placed on each pollution source to maintain the water quality standards for the river, mathematical models of the dissolved oxygen - biochemical oxygen demand relationship were developed for the two zones of the Ottawa River grossly impaired by these oxygen-consuming discharges.

In this chapter, the findings of the field investigations, modelling techniques, the evaluation of model parameters, and the calculation of allowable loadings are presented.

4.2 DO - BOD MODELLING

A flowing, unpolluted stream has an abundance of dissolved oxygen available for the use of the aquatic community. When unstable organic material from man-made or natural sources is introduced, biochemical oxidation utilizing the oxygen resources

of the watercourse proceeds. As the organic loading is increased, greater demands are placed on the streams oxygen supply and a point is reached where the rate of removal of dissolved oxygen (deoxygenation) is greater than the rate of atmospheric re-oxygenation. When this occurs the oxygen level in the stream begins to decrease and, in the extreme condition, can be completely depleted.

The purpose of DO/BOD modelling is to determine the level of organic loading that can be discharged to a watercourse and yet maintain a pre-determined level of dissolved oxygen.

A modified version of the Streeter-Phelps equation (Manhattan 1968) relating oxygen utilization to reaeration was employed for both the Zone 1-2 and Zone 4 surveys. This equation is written as follows:

$$D = \frac{K_d L_o}{K_2 - K_r} (e^{-K_r t} - e^{-K_2 t}) + D_o e^{-K_2 t} + \frac{S}{K_2} (1 - e^{-K_2 t})$$

- Where:
- D_o = dissolved oxygen deficit (pounds per day) at the point of reference [usually the point of waste discharge ($t = 0$)].
 - D = dissolved oxygen deficit (pounds per day) at any point, time t , from the point of reference.
 - L_o = ultimate biochemical oxygen demand loading (pounds per day) at the point of reference.
 - t = time of travel (days)
 - K_r = the coefficient of BOD removal in the watercourse by physical removal (sedimentation) and volatilization (per day base e)
 - K_d = the coefficient of deoxygenation (per day, base e)
 - K_2 = the coefficient of reoxygenation in the watercourse (per day, base e)
 - S = the rate of oxygen utilization by benthic deposits (pounds per unit area time).

Summaries of the data collected for modelling purposes are included below with a descriptive of the parameter calculation used in applying the above equation to the Ottawa River.

4.2.1 Field Investigation

Surveys designed to provide water quality and physical information necessary for mathematical modelling were conducted during 1968 and in the Zone 1-2 survey reach and 1969 in Zone 4 (see Zone Maps in Introduction). Activities included dye and drogue studies for time of travel and velocity, benthic respirometer studies to measure the oxygen demand of the bottom deposits and intensive water quality studies. The intensive studies were conducted over a 72-hour period under relatively low flow conditions during the month of August when the water temperature was high. All major sources of pollution were discharging at the time of these surveys. Sampling during the intensive studies was directed solely to surface dissolved oxygen, temperature and BOD₅ measurement. A tabulation of these data are presented in Table 4.1 for Zones 1 and 2 and in Table 4.2 for Zone 4.

The co-operation of both Ontario Hydro and Quebec Hydro was enlisted to lower flows to levels approximating design low flows. The flows occurring throughout both surveys are illustrated in Table 4.3.

TABLE 4.3

AVERAGE FLOW (CFS) DURING INTENSIVE SURVEYS

Location	July 22-26, 1968	August 4-8, 1969
Otto Holden	16,900	22,000
Des Joachims	21,700	25,700
Chenauux	25,100	32,000
Chats Falls	27,800	35,300
Carillon	48,500	56,600

4.2.2 Calculation of Model Parameters

a) BOD Removal and Deoxygenation

The coefficients of BOD removal (K_r) and deoxygenation (K_d) are approximated directly from a plot of the BOD₅ data collected during the intensive studies. The reaction rate is the slope of the line resulting from the plotting of the log of the BOD values versus time of travel.

From the surface BOD₅ data collected during the 1969 study of Zone 4, it appears that a large portion of the organic loading from the CIP Kipawa Mill is lost in the first one-half day's time of travel below the mill. The loss of BOD is not accompanied by a significant loss of dissolved oxygen and based on this fact and the accumulations of sludge found in the area, it was assumed that the BOD was settling to the stream bed. The slope derived from these points was assumed, therefore, to be a removal rate (K_r).

Throughout the rest of Zone 4 and the 1968 study of Zones 1 and 2, the loss of BOD was attributed primarily to the oxidation of organic materials and were assumed to be de-oxygenation rates (K_d).

The K_r and K_d rates thus established were employed in the modified Streeter-Phelps equation and, where necessary, were altered to more closely approximate the measured DO profiles.

b) Reoxygenation

Reoxygenation of a body of water occurs principally as a result of contact between the air-water interface. Oxygen diffuses from the atmosphere to the water at a rate determined by the amount of water coming in direct contact with the air. A turbulent stream obviously has a much greater ability for re-aeration than does a slow or stagnant stream. The coefficient K_2 is determined using a constant diffusivity coefficient (D_1) ft²/hr @ 20°C, average stream depth feet (H) and average velocity ft/hr (U) in the equation:

$$\frac{(D_1 \cdot U)^{1/2}}{H^{3/2}} \times 24 = K_2/\text{day} \quad (\text{Manhattan, 1968})$$

In the case of the Ottawa River, stream depths generally exceeding 50 feet limited the use of this equation which is generally recognized as being accurate for depths up to 10-12 feet. The results of employing the large "H" values are extremely small K_2 values (which are known through experience to be incorrect). Turbulence through wave action in the lake-like sections of the Ottawa River does affect reaeration and is not considered in the above equation. K_2 rates employed in the Ottawa River mathematical models were therefore estimated based on past modelling experience and adjusted to agree with the dissolved oxygen profiles.

c) Initial BOD and DO Loadings

Before a mathematical model can be produced a set of initial conditions must be established. In the case of the DO-BOD model, an initial oxygen deficit (D_0) and organic loading (L_0) are required.

The initial oxygen deficit (D_0) is determined from the survey findings. This value is the difference between the measured dissolved oxygen value and the 100 percent saturated DO value at survey water temperature. In the Zone 4 study, the initial conditions were measured at the dam at Temiskaming. Initial conditions in the Zone 1-2 study were measured at the Chaudiere Bridge between Ottawa and Hull.

The initial organic loadings (L_0) were similarly established using BOD measurements taken at these points. L_0 is expressed as pounds per day of ultimate biochemical oxygen demand (see (d)).

For use in the DO-BOD model the measured values of D_0 and L_0 are converted to pounds per day by multiplying the concentration (mg/l) by the streamflow (cfs) and a conversion factor (5.4.)

The formulation of a mathematical model requires a break in the calculations each time a significant waste source, tributary stream, physical change or K-rate change is encountered. At each break point, a new L_0 and D_0 must be established. These values are obtained from the final conditions computed in the previous section of the model plus any additional organic loading or oxygen deficit contributed by a waste source or tributary stream.

In the Ottawa River, the model had to be broken at a number of points, usually to account for a waste input, tributary stream input of physical change.

The waste inputs from the pulp and paper mills were determined from surveys conducted in the same time period as the river surveys. These are summarized in Table 4.4 along with results from other industrial waste surveys conducted during 1968 and 1969. These were combined with BOD inputs from the major municipalities and natural BOD levels to give the total BOD loadings used in the mathematical modelling. The tributary streams were high in dissolved oxygen and were generally beneficial. The two significant physical obstructions that required breakpoints in the models were the Otto Holden Dam in Zone 4 and the Carillon Dam in the Zone 1-2 study area. In both cases, dissolved oxygen levels measured above the dams showed significantly higher concentrations than samples taken below the dams. Since the studies were conducted to measure only the surface quality, these DO drops could not be completely explained at the time, however, subsequent investigations have revealed that in the head ponds behind each dam, dissolved oxygen stratification exists and since each dam draws its water for generating purposes from some distance below the surface, the water sampled downstream is essentially made up of sub-surface water from the upstream reach thus explaining the DO discrepancies. In each instance, the oxygen deficit D_0 below each dam was altered to account for this difference in oxygen levels.

d) Ultimate Biochemical Oxygen Demand

The measure of deoxygenating organic matter is the 5-day biochemical oxygen demand value. This analysis measures the amount of oxygen consumed in an airtight bottle over a 5-day period. It is not a measure of the entire organic loading but simply a convenient measure to be compared with other BOD₅ values.

In the stream, the organic loading obviously does not end after 5 days, therefore, the ultimate BOD concentration is required. This value is determined using a constant " K_1 ", which is a laboratory measurement of the rate of BOD satisfaction over a long period of time, usually 20-25 days. With the K_1 value known, all BOD₅ concentrations can be converted to ultimate BOD using the function $(1-10^{-K_1 t})^{-1}$ where t equals 5 days (EPA 1966).

The K_1 rate in Zone 4 was found to be 0.06/day and 0.058/day in the Zone 1-2 study.

e) Benthic Oxygen Demand

Decaying sludge deposits can have a significant demand on the oxygen resources of a watercourse and this sink of oxygen is not measured in BOD samples. It, therefore, must be handled as a separate term in the equation. In some instances, the benthic oxygen demand can be measured directly by finding the dissolved oxygen drop in a known volume of water trapped directly over the deposit, computing the oxygen demand per unit area per unit time and estimating the total area of the sludge deposit.

In the Ottawa River, oxygen uptake of the sludge deposits were considered significant where extensive sections of decaying sludge blanketed the bottom (Zone 2 - Mile 76-94; Zone 4 - Mile 366 to 372).

Direct measurement of the oxygen uptake rate was attempted but satisfactory results were not obtained. Examination of the sludge indicated that the decay rate would likely be slower than rates measured in other streams; therefore, a rate of one gram of oxygen per square meter-day was employed. This value is slightly less than the generally accepted range of 2-5 gm O₂/square meter-day (Stein 1966).

The value " S " employed in the modified Streeter-Phelps equation represents the oxygen uptake rate (pounds per square foot per day) multiplied by the average width of the deposit (feet), the

average velocity of the water over the deposit (feet/day) and the time interval (days).

4.2.3 Fitting the Model to the Observed Curve

Using the aforementioned rates (K_r , K_d , K_2 and S) and the initial organic loading and dissolved oxygen levels, the oxygen deficit (D) is computed for selected time intervals along the reach under consideration. From these results an oxygen profile is plotted. This curve is then compared to the oxygen profile measured during the field investigation. The closeness of the fit indicates the accuracy of the model.

As pointed out earlier, the depth of the Ottawa River precluded an accurate calculation of the reaeration rate (K_2). Consequently, the K_2 rates in both Ottawa River models required some adjustment in order to achieve good agreement between the observed and calculated oxygen sag curves.

The deoxygenation rates (K_d) were generally satisfactory, however, some changes were necessary in the upper reaches of Zone 4, where the BOD data indicated a much longer K_d rate than was actually needed.

Reaction rates and initial loading conditions for the Zone 1-2 and Zone 4 models are presented in Tables 4.1.1 and 4.1.2, respectively. Measured and computed oxygen profiles for Zones 1-2 and 4 are presented in Figures 4.1 and 4.2, respectively.

4.2.4 Allowable Loading Computation

Employing the model, maximum expected water temperatures and design low streamflows, organic waste loadings that would result in a minimum dissolved oxygen level of 5 mg/l were estimated.

Since storage reservoir development has increased throughout the period of record, the usual method of ranking low flow data and assigning a recurrence interval to each of the low flow events to determine design flow was not employed (1).

(1) Both Ontario Hydro and Hydro Quebec were instrumental in supplying the natural runoff records and in calculating the regulated discharges which probably would have occurred under present regulation procedures.

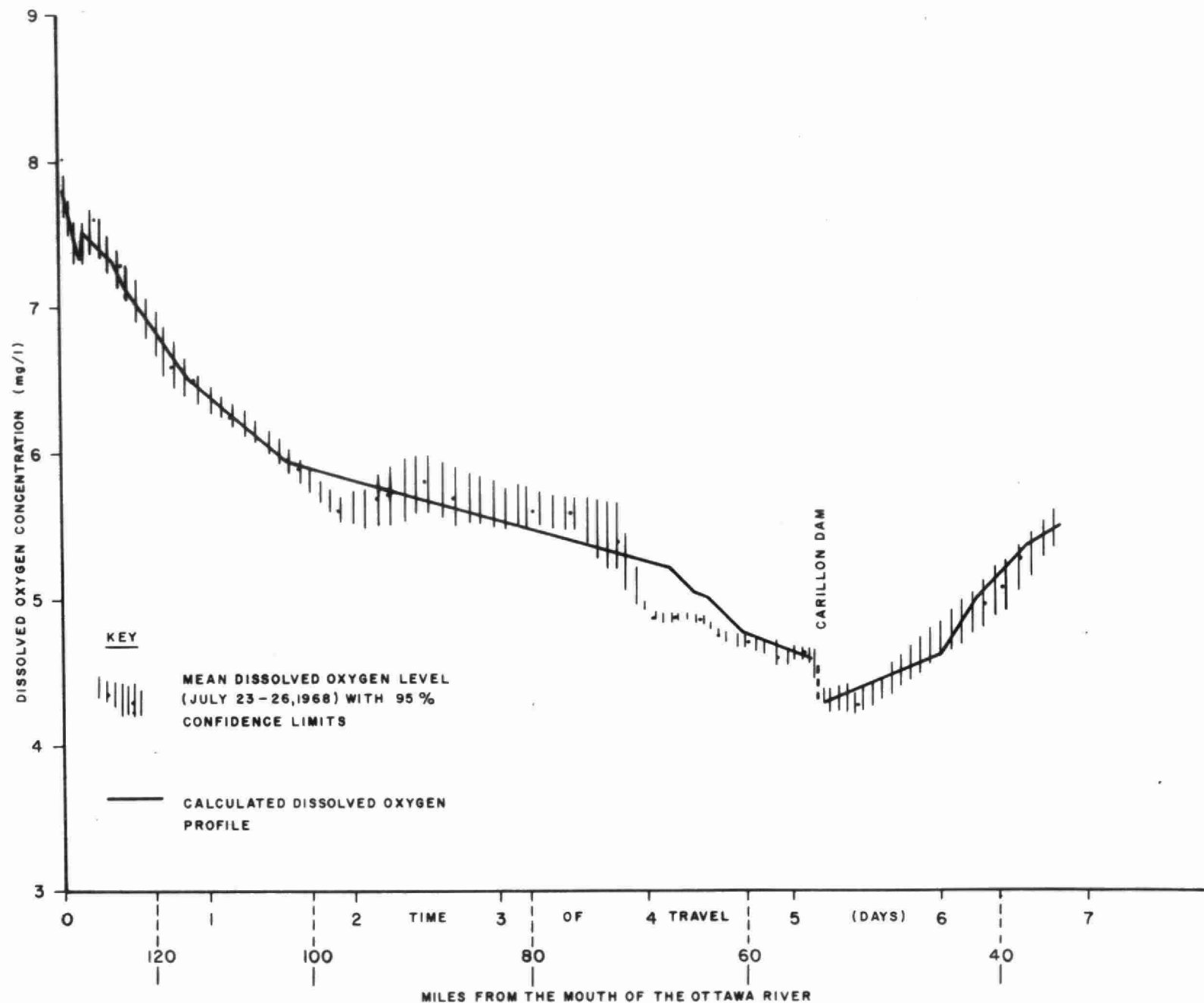


FIGURE 4.1 DISSOLVED OXYGEN PROFILE OTTAWA TO OKA

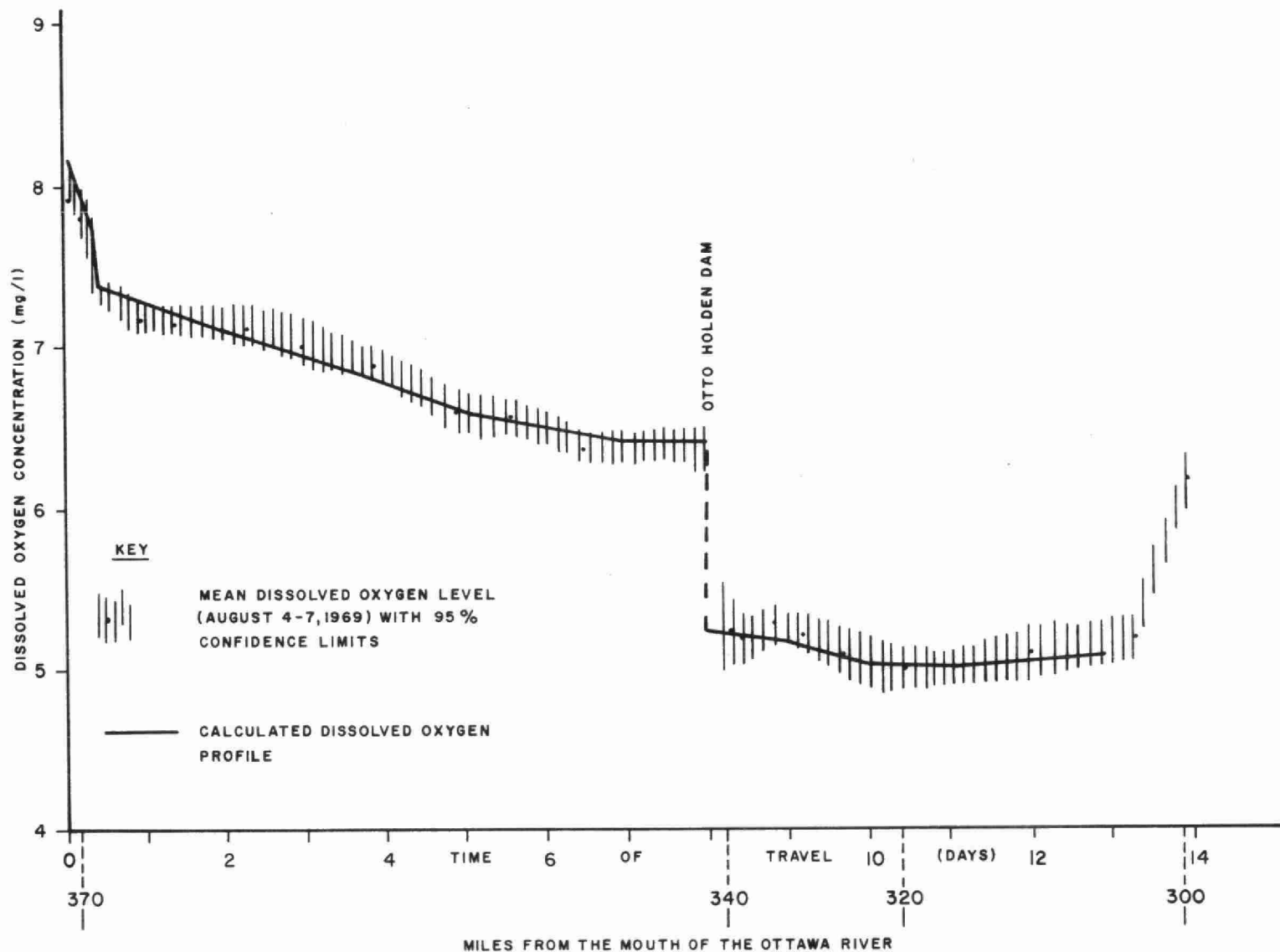


FIGURE 4.2 DISSOLVED OXYGEN PROFILE TEMISCAMING TO DES JOACHIMS

Instead, synthetic natural flows were analyzed by extreme value methods to produce what would be design flows under natural conditions.

Based on the results of this analysis, several years were selected whose low flows approximated the natural design low flows (Table 4.7). The synthetic natural flows for such years were then analyzed to produce regulated discharge values that would likely occur under current regulation procedures (Fig. 4.8) (1).

The streamflows obtained in this manner were then applied to the mathematical models as design flows (Table 4.9). Years were used to produce regulated discharge values that would likely occur under current regulation procedures (Fig. 4.8) (1). The low flows obtained in this manner were then applied to the mathematical model as design flows (Table 4.9).

The organic loading calculated from the model under design conditions (elevated water temperature and drought streamflow) represents the maximum biochemical oxygen demand loading that the stream could accept and yet maintain a satisfactory dissolved oxygen level. Of this total, acceptable BOD₅ loading, a portion was reserved for future development. The remainder was allotted to industries and municipalities discharging to the watercourse. These allotments are tabulated in Tables 4.2.1 and 4.2.2 in Volume I.

The deoxygenation rate employed is based on a reaction of the river to extremely high organic loadings. With treatment of the industrial and municipal discharges the nature of the treated waste inputs may be somewhat altered and once in the river organic stabilization may proceed at a rate that differs slightly from the calculated K_d rate employed in the model. Once the initial stages of industrial and municipal waste treatment are completed and the organic loading to the river has been substantially reduced, further surveys to 'fine tune' the model will be required.

REFERENCES

- Federal Water Pollution Control Assoc., "Water Quality Studies", U.S. Dept. of the Interior (FWPCA), Water Pollution Training Activities Text, 1966.
- Manhattan, "Stream and Estuarine Analysis", Summer Institute in Water Pollution Control, Manhattan College, New York, 1968.
- Ontario Water Resources Commission, "Outlines of Analytical Methods", Division of Laboratories, 1970.
- Stein, J.E. and J.G. Denison, "*In Situ* Benthic Oxygen Demand of Cellulosic Fibres", Advances in Water Pollution Research, Vol. 3, 1966.

TABLE 4.1

SURVEY DATA SUMMARIES
ZONES 1 AND 2

Note:

The units of the parameters are:

temperature - °C

dissolved oxygen - mg/l, and

BOD₅ - mg/l.

Both temperature and dissolved oxygen were measured in situ using YSI and EIL meters that were calibrated by the Winkler method. The BOD was measured in the OWRC laboratories (OWRC, 1970).

TABLE 4.1
SURVEY DATA SUMMARIES
ZONES 1 and 2

*intensive
Sep 167*

Location: RM 129.9

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	24.3	25.3	23.0		18
Dissolved	8.05	9.0	7.0	0.68	18
Oxygen					
BOD	0.93	1.3	0.4	0.33	8

Location: RM 128.5
Distance from Shore: 700'

Temperature	24.6	27.0	23.0		18
Dissolved	7.62	9.0	6.5	0.68	18
Oxygen					
BOD	3.76	5.4	3.1	0.67	9

Distance from Shore: 1300'

Temperature	24.5	27.0	23.0		18
Dissolved	7.69	9.0	7.0	0.64	18
Oxygen					
BOD	2.67	4.0	1.5	0.94	9

Location: RM 128.1
Brewery Creek at mouth

Temperature	24.5	26.0	23.0		17
Dissolved	7.76	9.0	6.5	0.59	17
Oxygen					
BOD	3.21	10.4	1.2	2.98	8

Location RM 127.8
Lake Creek at mouth

Temperature	24.2	26.0	22.0		17
Dissolved	8.00	9.0	7.0	0.63	17
Oxygen					
BOD	1.04	1.8	0.4	0.46	8

TABLE 4.1 (continued)

Location: RM 128.1
Rideau River at Mouth

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	25.1	27.8	21.0		17
Dissolved Oxygen	7.26	9.0	5.0	1.09	17
BOD	2.09	3.7	1.4	0.70	9

Location: RM 127.5
Distance from Shore: 600'

Temperature	24.4	26.5	22.0		18
Dissolved Oxygen	7.26	8.0	6.0	0.51	18
BOD	2.63	3.4	1.3	1.16	3

Distance from Shore: 1000'

Temperature	24.4	26.0	23.0		18
Dissolved Oxygen	7.48	8.5	6.0	0.66	18
BOD	1.53	2.4	0.6	0.90	3

Location: RM 127.3
Gatineau River at Mouth

Temperature	23.9	25.2	23.0		18
Dissolved Oxygen	8.07	9.0	6.5	0.75	18
BOD	0.99	1.5	0.5	0.33	9

Location: RM 125.0
North of Kettle Island

Temperature	23.8	27.0	22.5		12
Dissolved Oxygen	7.55	8.0	7.1	0.28	12
BOD	1.57	2.4	1.3	0.42	6

TABLE 4.1 (continued)

Location: RM 125.0

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	23.6	26.0	22.0		23
Dissolved Oxygen	7.53	8.2	7.0	0.28	23
BOD	1.61	2.4	0.8	0.42	18

Location: RM 123.7
North of Kettle Island

Temperature	23.7	27.0	22.0		12
Dissolved Oxygen	7.18	8.2	6.7	0.36	12
BOD	3.67	5.6	2.4	0.99	10

Location: RM 123.7

Temperature	23.5	26.0	22.5		22
Dissolved Oxygen	7.32	7.6	7.0	0.22	22
BOD	1.55	2.6	0.7	0.64	18

Location: RM 121.8
South of Lower Duck Island

Temperature	23.2	26.0	22.0		10
Dissolved Oxygen	7.23	7.8	7.0	0.22	10
BOD	1.98	3.1	1.0	0.84	9

Location: RM 119.5
Distance from Shore: 400'

Temperature	23.3	25.0	22.5		10
Dissolved Oxygen	4.72	6.0	3.6	0.87	10
BOD	6.29	9.6	4.2	1.84	9

TABLE 4.1 (continued)

Distance from Shore: 800'

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	23.6	25.0	22.5		10
Dissolved Oxygen	6.62	7.1	6.2	0.30	10
BOD	3.27	6.0	1.5	1.67	9

Distance from Shore: 1200'

Temperature	23.5	25.0	22.5		10
Dissolved Oxygen	6.95	7.3	6.5	0.21	10
BOD	1.49	1.8	1.1	0.24	9

Location: RM 116.7
Distance from Shore: 600'

Temperature	23.5	26.0	22.8		10
Dissolved Oxygen	6.47	6.9	5.5	0.43	10

Distance from Shore: 1,300'

Temperature	23.7	26.5	22.8		10
Dissolved Oxygen	6.73	7.0	6.5	0.12	10

Location: RM 113.4
Distance from Shore: 800'

Temperature	24.0	26.0	23.0		34
Dissolved Oxygen	6.41	7.0	5.7	0.38	34
BOD	1.58	1.9	1.1	0.26	8

Distance from Shore: 1,600'

Temperature	24.0	26.0	23.0		34
Dissolved Oxygen	6.55	7.5	6.0	0.38	34
BOD	1.61	2.7	1.1	0.54	9

TABLE 4.1 (continued)

Location: RM 113.3
Lievre River at Mouth

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	23.9	24.0	23.5		24
Dissolved Oxygen	7.60	8.5	7.0	0.44	24
BOD	0.85	1.5	0.4	0.30	10

Location: RM 112.3
Distance from Shore: 700'

Temperature	23.9	26.0	22.5		34
Dissolved Oxygen	6.45	7.5	5.5	0.49	34

Distance from Shore: 1500'

Temperature	24.0	25.5	23.0		34
Dissolved Oxygen	6.46	7.5	5.5	0.41	34

Location: RM 104.5

Temperature	24.0	26.0	23.0		25
Dissolved Oxygen	6.17	7.0	5.8	0.28	25
BOD	1.18	1.8	0.9	0.32	6

Location: RM 103.2

Temperature	24.1	27.0	23.0		34
Dissolved Oxygen	5.95	6.5	5.5	0.21	34
BOD	1.27	1.8	0.8	0.30	14

Location: RM 103.1
Blanche River at Mouth

Temperature	24.7	26.0	23.0		24
Dissolved Oxygen	7.91	9.0	7.0	0.74	24
BOD	0.82	1.1	0.4	0.21	13

TABLE 4.1 (continued)

Location: RM 101.5

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	24.0	27.0	23.0		66
Dissolved Oxygen	5.86	7.0	5.0	0.39	66
BOD	1.15	1.7	0.5	0.30	26

Location: RM 95.2

Temperature	23.5	25.0	23.0		9
Dissolved Oxygen	5.62	5.9	5.4	0.13	9

Location: RM 95.0
Petite Nation River at Mouth

Temperature	24.0	26.0	23.0		9
Dissolved Oxygen	7.94	10.0	7.0	0.97	9
BOD	1.43	2.3	0.9	0.51	7

Location: RM 95.0
South Nation River at Mouth

Temperature	24.6	26.0	23.8		9
Dissolved Oxygen	6.30	8.1	5.3	0.99	9
BOD	1.41	1.8	1.0	0.28	7

Location: RM 93.1

Temperature	23.7	25.0	23.0		18
Dissolved Oxygen	5.70	6.4	5.2	0.29	18
BOD	1.18	2.0	0.6	0.31	18

Location: RM 90.1

Temperature	23.7	25.0	23.0		9
Dissolved Oxygen	5.76	6.4	5.3	0.29	9
BOD	2.3	2.3	2.3	-	1

TABLE 4.1 (continued)

Location: RM 87.3

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	23.9	25.5	23.2		9
Dissolved Oxygen	5.80	6.1	5.3	0.25	9
BOD	1.17	1.5	0.7	0.27	7

Location: RM 85.6

Temperature	24.1	26.0	23.0		9
Dissolved Oxygen	5.70	5.2	6.2	0.26	9
BOD	0.7	0.7	0.7	-	1

Location: RM 78.6

Temperature	23.9	25.0	23.2		9
Dissolved Oxygen	5.65	5.9	5.5	0.18	9
BOD	0.8	0.8	0.8	-	1

Location: RM 75.4

Temperature	23.9	25.0	23.0		9
Dissolved Oxygen	5.57	5.8	5.4	0.17	9

Location: RM 73.2
Rouge River at Mouth

Temperature	23.3	24.0	22.8		9
Dissolved Oxygen	8.45	9.2	8.1	0.27	9
BOD	1.10	1.5	0.6	0.31	7

Location: RM 70.8

Temperature	23.8	25.0	23.0		9
Dissolved Oxygen	5.42	6.0	4.8	0.38	9
BOD	0.88	1.4	0.6	0.27	8

TABLE 4.1 (continued)

Location: RM 68.0
Distance from Shore: 400'

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	23.9	24.3	23.6		18
Dissolved Oxygen	4.82	5.0	4.6	0.08	18
BOD	1.10	2.4	0.4	0.59	10

Location: RM 68.0
Distance from Shore: 800'

Temperature	23.9	24.3	23.9		18
Dissolved Oxygen	4.85	5.0	4.8	0.08	18
BOD	5.54	15.6	0.5	5.48	11

Location: RM 66.0

Temperature	23.9	24.3	23.8		18
Dissolved Oxygen	4.85	5.1	4.8	0.10	18
BOD	0.80	1.2	0.4	0.28	6

Location: RM 64.0

Temperature	24.0	24.3	23.6		18
Dissolved Oxygen	4.84	5.1	4.7	0.10	18

Location: RM 62.5

Temperature	24.1	24.6	23.7		18
Dissolved Oxygen	4.75	5.0	4.7	0.10	18

Location: RM 60.4

Temperature	24.1	24.7	23.8		18
Dissolved Oxygen	4.69	5.0	4.6	0.10	18
BOD	1.22	1.5	0.4	0.31	11

TABLE 4.1 (continued)

Location: RM 58.4					
Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	24.0	24.6	23.6		18
Dissolved Oxygen	4.65	4.9	4.3	0.14	18
Location: RM 56.8					
Temperature	24.2	24.7	23.8		18
Dissolved Oxygen	4.68	5.0	4.5	0.12	18
BOD	1.01	1.5	0.5	0.28	
Location: RM 56.4					
Temperature	24.0	24.6	23.0		17
Dissolved Oxygen	4.27	4.7	3.5	0.27	17
Location: RM 53.0					
Temperature	24.0	24.6	23.0		17
Dissolved Oxygen	4.28	4.8	3.9	0.22	17
Location: RM 52.6 North River at Mouth					
Temperature	25.3	27.0	24.0		17
Dissolved Oxygen	6.43	7.7	5.3	0.80	17
BOD	1.27	1.9	0.8	0.31	14
Location: RM 51.0					
Temperature	24.1	24.8	23.0		17
Dissolved Oxygen	4.23	4.6	3.9	0.17	17
BOD	0.86	1.5	0.4	0.28	16

TABLE 4.1 (continued)

Location: RM 49.8

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	24.1	25.0	22.5		34
Dissolved	4.22	4.5	3.9	0.16	34
Oxygen					

Location: RM 43.8

Temperature	24.1	24.8	22.5		36
Dissolved	4.69	5.6	4.3	0.33	36
Oxygen					
BOD	0.86	2.3	0.3	0.38	33

Location: RM 40.4

Temperature	24.0	25.3	23.0		17
Dissolved	5.07	5.8	5.1	0.41	17
Oxygen					

Location: RM 37.4

Temperature	23.9	25.3	22.5		17
Dissolved	5.52	6.0	4.9	0.31	17
Oxygen					
BOD	0.89	1.9	0.4	0.40	16

TABLE 4.2

SURVEY DATA SUMMARIES

ZONE 4

Note:

The units of the parameters are:

temperature - °C

dissolved oxygen - mg/l, and

BOD₅ - mg/l.

Both temperature and dissolved oxygen were measured in situ using YSI and EIL meters that were calibrated by the Winkler method. The BOD was measured in the OWRC laboratories (OWRC, 1970).

TABLE 4.2
SURVEY DATA SUMMARIES
ZONE 4

Location: RM 372.4
Distance from Shore: 1080'

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	20.8	22.0	19.5		2
Dissolved Oxygen	7.9	8.0	7.8	-	2
BOD	39.0	50.0	28.0	-	2

Distance from Shore: 360'

Temperature	19.8	21.0	18.8		10
Dissolved Oxygen	8.22	8.4	8.0	0.21	10
BOD	0.65	1.0	0.2	0.28	9

Location: RM 371.9
Distance from Shore: 150'

Temperature	19.7	20.5	18.9		10
Dissolved Oxygen	7.99	8.2	7.6	0.21	10
BOD	5.58	7.3	4.2	1.37	5

Distance from Shore: 300'

Temperature	19.5	20.3	18.7		10
Dissolved Oxygen	8.19	8.4	8.0	0.14	10
BOD	4.32	7.8	2.2	2.34	5

Distance from Shore: 450'

Temperature	19.5	20.5	18.7		10
Dissolved Oxygen	8.19	8.4	8.0	0.15	10
BOD	1.52	2.2	1.0	0.50	5

TABLE 4.2 (continued)

Location: RM 366.4
Distance from Shore: 255'

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	21.3	24.0	19.3		10
Dissolved Oxygen	7.27	7.6	6.9	0.23	10
BOD	1.74	2.6	1.0	0.51	7

Distance from Shore: 510'

Temperature	21.2	23.5	19.5		10
Dissolved Oxygen	7.28	7.7	6.9	0.26	10
BOD	1.59	2.5	1.0	0.65	7

Distance from Shore: 765'

Temperature	21.1	23.0	19.8		9
Dissolved Oxygen	7.32	7.6	7.0	0.19	9
BOD	1.37	2.1	0.8	0.41	7

Location: RM 363.8
Distance from Shore:

Temperature	21.4	23.0	19.9		20
Dissolved Oxygen	7.01	7.4	6.7	0.16	20
BOD	1.29	1.6	1.0	0.20	19

Location: RM 362.3

Temperature	21.5	23.3	20.0		29
Dissolved Oxygen	6.99	7.3	6.7	0.30	29
BOD	1.18	2.0	0.8	0.29	26

Location: RM 358.7

Temperature	21.5	23.3	20.0		20
Dissolved Oxygen	6.92	7.5	6.2	0.37	20
BOD	1.13	2.0	0.7	0.37	17

TABLE 4.2 (continued)

Location: RM 355.7

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	22.0	23.5	20.2		20
Dissolved Oxygen	6.71	7.4	5.8	0.37	20
BOD	1.14	2.2	0.7	0.36	18

Location: RM 353.1

Temperature	21.7	23.0	21.0		20
Dissolved Oxygen	6.66	7.1	6.4	0.25	20
BOD	1.07	2.4	0.7	0.43	18

Location: RM 370.8
Distance from Shore: 150'

Temperature	19.7	21.0	18.7		10
Dissolved Oxygen	7.95	8.5	7.6	0.25	10
BOD	4.92	5.6	4.0	0.68	6

Distance from Shore: 300'

Temperature	19.6	20.9	18.8		10
Dissolved Oxygen	7.96	8.2	7.7	0.15	10
BOD	4.60	5.5	2.5	1.12	6

Distance from Shore: 450'

Temperature	19.6	20.4	18.7		10
Dissolved Oxygen	8.07	8.3	7.7	0.20	10
BOD	3.50	5.0	1.3	1.56	6

Distance from Shore: 600'

Temperature	19.6	20.6	18.5		9
Dissolved Oxygen	8.12	8.3	7.9	0.15	9
BOD	1.87	3.9	0.6	1.25	6

TABLE 4.2 (continued)

Distance from Shore: 900'

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	19.4	20.4	18.5		10
Dissolved Oxygen	8.07	8.3	7.8	0.16	10
BOD	1.33	2.1	0.9	0.43	6

Location: RM 369.3
Distance from Shore: 360'

Temperature	19.6	20.5	18.5		10
Dissolved Oxygen	7.79	8.1	7.4	0.21	10
BOD	2.72	3.2	2.2	0.41	6

Distance from Shore: 720'

Temperature	19.4	20.6	18.5		10
Dissolved Oxygen	7.94	8.1	7.7	0.13	10
BOD	2.65	2.9	2.2	0.26	6

Distance from Shore: 1080'

Temperature	19.5	20.9	18.4		10
Dissolved Oxygen	7.90	8.1	7.6	0.19	10
BOD	2.53	2.9	2.1	0.31	6

Location: RM 349.8

Temperature	21.4	23.2	20.0		20
Dissolved Oxygen	6.43	7.1	6.0	0.34	20
BOD	1.12	1.8	0.6	0.41	18

Location: RM 347.6

Temperature	21.5	23.2	19.8		20
Dissolved Oxygen	6.38	6.7	6.0	0.27	20
BOD	1.15	2.1	0.8	0.36	17

TABLE 4.2 (continued)

Location: RM 345.1

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	21.5	23.0	20.0		30
Dissolved	6.20	6.6	5.9	0.23	30
Oxygen					
BOD	1.09	1.7	0.5	0.32	27

Location: RM 341.3

Temperature	22.0	24.5	20.2		27
Dissolved	6.15	6.7	5.9	0.30	27
Oxygen					
BOD	1.10	1.5	0.6	0.24	21

Location: RM 339.7

Temperature	19.4	21.6	18.0		22
Dissolved	5.32	7.2	4.3	0.58	22
Oxygen					
BOD	1.03	1.6	0.8	0.22	26

Location: RM 337.2

Temperature	19.8	23.0	18.5		22
Dissolved	5.21	7.1	4.3	0.34	22
Oxygen					
BOD	0.88	1.4	0.3	0.27	26

Location: RM 336.7
Mattawa River at mouth

Temperature	23.8	26.0	22.8		11
Dissolved	7.05	8.0	4.8	0.88	11
Oxygen					
BOD	0.62	1.0	0.4	0.19	13

Location: RM 333.5

Temperature	20.2	23.0	18.5		36
Dissolved	5.33	6.0	4.3	0.40	36
Oxygen					
BOD	0.97	2.4	0.4	0.39	39

TABLE 4.2 (continued)

Location: RM 329.9

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	20.1	21.7	19.0		24
Dissolved Oxygen	5.22	6.5	4.3	0.43	24
BOD	0.94	1.4	0.5	0.23	25

Location: RM 326.3

Temperature	20.0	22.0	18.0		26
Dissolved Oxygen	5.13	6.5	4.6	0.49	26
BOD	0.85	1.3	0.3	0.22	28

Location: RM 322.7

Temperature	20.4	22.0	19.0		26
Dissolved Oxygen	5.02	5.7	4.3	0.41	26
BOD	0.95	1.8	0.3	0.32	28

Location: RM 318.4

Temperature	20.4	22.2	19.0		26
Dissolved Oxygen	4.97	5.6	4.3	0.42	26
BOD	0.90	1.4	0.5	0.25	27

Location: RM 313.6

Temperature	20.4	22.1	19.3		26
Dissolved Oxygen	4.97	5.6	4.3	0.34	26
BOD	0.90	1.4	0.5	0.25	27

Location: RM 313.6

Temperature	20.4	22.1	19.3		26
Dissolved Oxygen	4.97	5.6	4.3	0.34	26
BOD	0.91	2.7	0.4	0.43	28

TABLE 4.2 (continued)

Location: RM 309.8

Parameter	Average	Maximum	Minimum	Standard Deviation	No. of Samples
Temperature	20.8	23.0	19.4		26
Dissolved Oxygen	5.02	5.7	4.0	0.51	26
BOD	0.81	1.3	0.4	0.25	28

Location: RM 303.6

Temperature	20.8	22.5	19.5		26
Dissolved Oxygen	5.13	5.7	4.4	0.40	26
BOD	0.76	1.3	0.3	0.28	28

Location: RM 301.0

Temperature	21.5	23.0	20.0		22
Dissolved Oxygen	6.02	6.8	5.0	0.57	22
BOD	0.69	1.1	0.4	0.19	23

Location: RM 289.5

Temperature	22.0	24.0	19.5		25
Dissolved Oxygen	7.13	7.9	6.0	0.62	25
BOD	0.73	1.3	0.3	0.26	26

Location: RM 285.8

Temperature	22.8	24.9	20.0		24
Dissolved Oxygen	7.67	8.9	6.3	0.82	24
BOD	0.76	1.3	0.3	0.24	24

Location: RM 282.3

Temperature	22.7	25.5	19.5		25
Dissolved Oxygen	7.73	9.7	6.5	0.93	25
BOD	0.82	1.9	0.3	0.34	24

TABLE 4.4

INDUSTRIAL WASTES SURVEY SUMMARIES

Note:

All results presented are mean values given in pounds per day, except for the discharge flow figures which are mean values given in million imperial gallons per day. All surveys had a duration of at least 24 hours.

TABLE 4.4
INDUSTRIAL WASTES SURVEY SUMMARIES

CANADIAN INTERNATIONAL PAPER COMPANY LTD.,
TEMISCAMINGUE, P.Q.
(R.M. 372.3)

Survey Dates: July 8-11, 1968

Pulp Production:	Process Sulfite	Tons/Day			
Outfall	Flow	BOD lbs/day	Total Solids	Suspended Solids	Volatile Solids
Woodroom	10.0	14,700	74,300	9,700	47,500
Main mill	74.2	244,000	1,200,000	81,000	950,000
Totals	84.2	258,700	1,274,300	90,700	997,500

Survey Dates: July 21-24, 1969

Pulp Production:	Process Sulfite	Tons/Day 440			
Woodroom	21	34,600	115,000	26,000	65,500
Main mill	63	285,000	1,290,000	79,000	1,040,000
Deflour	11	22,200	101,000	25,400	81,000
Totals	95	341,800	1,506,000	130,400	1,186,500

Survey Dates: July 30-August 7, 1969

Pulp Production:	Process Sulfite	Tons/Day 332			
Woodroom	13.3	30,000	70,500	19,600	41,200
Main mill	69.2	337,000	1,150,000	80,200	915,000
Deflour	18.6	42,500	194,500	30,800	150,000
Totals	101.1	409,500	1,415,000	130,600	1,106,200

TABLE 4.4 (continued)

CONSOLIDATED BATHURST CO. LTD.
 PORTAGE DU FORT, P.Q.
 (R.M. 188.7)

Survey Dates: August 6-9, 1968

Pulp Production:		Process Kraft	Tons/Day		
Outfall	Flow	BOD lbs/day	Total Solids	Suspended Solids	Volatile Solids
Lagoon effluent	13.0	31,900	136,000	6,100	44,100
Mixed effluent to river	20.0	37,500	206,000	-	-

Survey Dates: July 14-17, 1969

Pulp Production:		Process Kraft	Tons/Day 498		
Alkaline	2.4	7,300	94,500	2,700	30,300
Limerock bed	10.0	15,100	168,000	8,600	47,000
High BOD	13.4	19,600	76,000	22,800	36,700
Totals	25.8	42,000	338,500	34,100	114,000
Mixed effluent to river	24.4	41,700	292,000	17,900	95,000

TABLE 4.4 (continued)

E.B. EDDY CO. LTD.
HULL, P.Q.
(R.M. 129.9)

Survey Dates: June 18-21, 1968

Pulp Production: Process Tons/Day
Groundwood
Sulfite

Outfall	Flow mgd	BOD lbs/day	Total Solids	Suspended Solids	Volatile Solids
Woodroom	6.0	22,700	54,400	11,100	40,900
Groundwood	1.2	140	1,500	500	900
Mill "B"	1.9	2,200	22,100	18,000	12,900
Main Lower mill	10.0	96,200	356,000	14,200	171,000
Totals	19.1	121,240	434,000	43,800	225,700

Survey Dates: July 28-31, 1969

Pulp Production: Process Tons/Day
Groundwood 168
Sulfite 246

Woodroom	5.7	21,200	63,600	11,000	38,700
Groundwood	1.5	900	4,400	2,100	3,500
Mill "B"	1.4	1,300	9,200	5,100	3,200
Main Lower mill	13.8	12,900	43,500	23,400	30,300
Bleach plant	0.8	62,100	300,000	2,200	150,000
Blow pit	1.0	2,300	11,400	300	6,600
Totals	24.2	100,700	432,100	44,100	232,300

TABLE 4.4 (continued)

E.B. EDDY CO. LTD.
OTTAWA, ONTARIO
(R.M. 129.9)

Survey Dates: July 23-26, 1968

Outfall	Flow mgd	BOD lbs/day	Total Solids	Suspended Solids
Totals	4.6	5,200	38,000	25,600

Survey Dates: July 29-August 1, 1969

Totals	4.2	5,600	39,800	25,200
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CANADA PACKERS LTD.,
HULL, P.Q.
(R.M. 128.1)

Survey Dates: July 8-10, 1969

Outfall	Flow mgd	BOD lbs/day	Total Solids	Suspended Solids	Volatile Solids
Effluent to Brewery Creek	0.74	8,500	12,300	4,300	7,600

TABLE 4.4 (continued)

CANADIAN INTERNATIONAL PAPER CO. LTD.
GATINEAU, P.Q.
(R.M. 124.7)

Survey Dates: July 23-26, 1968

Pulp Production:	Process	Tons/Day
	Groundwood	721
	Sulfite	290

Outfall	Flow mgd	BOD lbs/day	Total Solids	Suspended Solids	Volatile Solids
Sewer "A"	2.5	400	4,800	2,300	1,400
Alcohol	1.5	43,600	223,000	17,200	170,000
Plant "B"					
Main Mill	23.6	39,500	141,900	31,100	106,500
"C"					
Masonite	3.6	94,100	127,800	17,900	108,700
"E"					
Sewer "F"	8.4	18,900	56,900	21,000	41,100
Bark Screen	5.1	4,500	17,400	9,200	12,000
- slasher					
Totals	44.7	201,000	571,800	98,700	439,700

Survey Dates: June 16-19, 1969

Pulp Production:	Process	Tons/Day
	Groundwood	1,009
	Sulfite	384

Sewer "A"	5.7	5,500	30,500	20,700	25,500
Alcohol	2.4	155,000	560,000	9,000	467,000
Plant "B"					
Main Mill	28.5	39,400	134,000	23,500	98,000
"C"					
Masonite	0.9	23,400	47,500	7,100	45,000
"E"					
Sewer "F"	6.9	13,300	82,000	33,300	60,000
Bark Screen	6.0	8,800	29,500	9,500	14,600
- slasher					
Totals	50.4	245,400	883,500	103,100	710,100

TABLE 4.4 (continued)

ELECTRIC REDUCTION CO. OF CANADA LTD.
BUCKINGHAM, P.Q.
(R.M. 113.3)

Survey Dates: October 14-16, 1969

Outfall	Flow mgd	BOD lbs/day	Total Solids	Suspended Solids	Volatile Solids
#1	3.9	54	2,600	270	550
#2	1.0	15	700	60	220
#3	.33	4	500	33	63
#4	.05	1	36	4	8
#5	1.5	39	3,300	210	630
Totals	6.8	113	7,100	580	1,500

JAMES MACLAREN CO. LTD.
MASSON, P.Q.
(R.M. 113.3)

Survey Dates: July 2-5, 1968

Outfall	Flow mgd	BOD lbs/day	Total Solids	Suspended Solids	Volatile Solids
Pulp Production:		Process Groundwood Sulfite	Tons/Day 320 90		
Main Mill	6.1	33,600	207,000	6,200	150,000
Wash Drum	0.8	250	1,400	900	900
Blog Block Sluice	14.2	130	10,000	1,000	5,000
Totals	21.1	34,000	218,400	8,100	155,900

Survey Dates: September 2-5, 1969

Outfall	Flow mgd	BOD lbs/day	Total Solids	Suspended Solids	Volatile Solids
Pulp Production:		Process Groundwood Sulfite	Tons/Day 350 99		
Main Mill	8.1	45,900	242,000	9,300	176,000
Wash Drum	1.0	220	2,000	1,100	1,400
Blog Block Sluice	17.0	300	16,500	2,100	7,100
Barking Mill	2.2	3,100	12,100	8,200	9,900
Totals	28.3	49,500	272,600	20,700	194,400

TABLE 4.4 (continued)

THURSO PULP AND PAPER CO. LTD.
 THURSO, P.Q.
 (R.M. 102.8)

Survey Dates: July 2-5, 1968

Pulp Production: Process Kraft Tons/Day

Outfall	Flow mgd	BOD lbs/day	Total Solids	Suspended Solids	Volatile Solids
Lagoon Outlet	14.7	21,800	163,000	15,700	35,500

Survey Dates: July 7-10, 1969

Pulp Production: Process Kraft Tons/Day
333

Bleached Stock	0.2	240	2,900	400	1,400
Digester	8.8	27,100	268,000	165,000	73,000
Paper machine	0.1	20	200	30	120
Causticizing	0.3	800	170,000	150,000	4,000
Woodroom	4.5	15,800	75,000	19,000	39,000
Alkaline	0.6	1,000	45,000	37,000	5,000
Totals to Lagoon	14.5	44,960	561,100	371,400	122,500
Lagoon Outlet	15.1	41,000	168,000	63,000	83,500

TABLE 4.4 (continued)

CANADIAN INTERNATIONAL PAPER CO. LTD.
 HAWKESBURY, ONTARIO
 (R.M. 68.0)

Survey Dates: July 23-26, 1968

Pulp Production: Process Tons/Day
 Sulfite 250

Outfall	Flow mgd	BOD lbs/day	Total Solids	Suspended Solids
Wood Yard #1	0.3	14	400	40
Wood Yard #2		260	9,000	7,900
Sludge Lagoon		4,900	28,300	2,500
Lower Lagoon	22.1	244,000	641,000	7,500
Totals	24.0	249,000	678,700	18,000

Survey Dates: July 28-31, 1969

Pulp Production: Process Tons/Day
 Sulfite

Sludge Lagoon	1.3	15,000		2,000
Lower Lagoon	20.0	190,000		7,000
Totals	21.3	205,000		9,000

TABLE 4.5

OTTAWA RIVER ZONES 1 AND 2
REACTION RATES AND LOADING VALUES EMPLOYED IN THE MATHEMATICAL MODEL

Section Mile to Mile	Time of Travel (days) to		Stream- flow (cfs)	Water Temper- ature °C	DO mg/l	L _O (lbs/day)	K _r	K _d	K ₂	S
I 129 to 126.9	0.00	0.17	28,400	25	7.71	675,000	0.635	0.635	0.11	0
II 126.9 to 123.7	0.17	0.34	42,650	25	7.46	760,000	0.635	0.635	0.575	0
III 123.7 to 122.1	0.34	0.43	42,650	25	7.22	1,064,000	0.615	0.615	0.50	0
IV 122.1 to 113.3	0.43	0.92	42,650	25	7.03	1,068,000	0.615	0.615	0.50	0
V 113.3 to 107.0	0.92	1.55	47,800	25	6.39	940,000	0.40	0.40	0.20	0
VI 102.8 to 93.7	1.55	2.15	47,800	25	5.86	776,000	0.30	0.30	0.20	0
VII 93.7 to 75.7	2.15	3.50	47,800	25	5.68	648,170	0.195	0.195	0.08	30,000

TABLE 4.5 (continued)

Section Mile to Mile	Time of Travel (days) to		Stream- flow (cfs)	Water Temper- ature °C	DO mg/l	L _o (lbs/day)	K _r	K _d	K ₂	S
VIII 75.9 to 68.0	3.50	4.07	47,800	25	5.26	498,151	0.195	0.195	0.08	0
IX 68.0 to 63.4	4.07	4.40	48,800	25	5.20	970,000	0.69	0.69	0.43	0
X 63.4 to 56.8	4.40	5.15	48,800	25	4.92	772,472	0.465	0.465	0.16	0
XI 56.8 to 51.7	5.15	5.15	48,800	25	4.20	545,033	0.465	0.465	0.25	0
XII 51.7 to 47.1	5.45	5.75	48,800	25	4.24	474,066	0.305	0.305	0.25	0
XIII 47.1 to 43.8	5.75	6.05	48,800	25	4.39	432,614	0.195	0.195	0.25	0
XIV 43.8 to 37.4	6.05	6.80	48,800	25	4.59	408,032	0.125	0.125	0.40	0

TABLE 4.6

OTTAWA RIVER - ZONE 4
REACTION RATES AND LOADING VALUES EMPLOYED IN THE MATHEMATICAL MODEL

Section Mile to Mile	Time of Travel (days) to		Stream- flow (cfs)	Water Temper- ature °C	DO mg/l	L _O (lbs/day)	K _r	K _d	K ₂	S
I 372.3 to 366.4	0.00	0.50	20,300	20	8.18	960,000	1.90	0.30	0.25	20,000
II 366.4 to 349.5	0.50	5.00	20,300	20	7.42	371,271	0.07	0.07	0.01	0
III 349.5 to 340.9	5.00	8.00	20,300	20	6.60	270,949	0.04	0.04	0.01	0
IV 340.9 to 314.4	8.00	11.00	20,300	20	5.25	240,310	0.085	0.085	0.02	0
V 314.9 to	11.00	13.00	20,300	20	5.00	186,220	0.02	0.02	0.02	0

TABLE 4.7

FLOWS UNDER CURRENT REGULATION PROCEDURES

Otto Holden* *Cave Rapids*

	1953		1955		1962	
	Monthly	Weekly	Monthly	Weekly	Monthly	Weekly
May	28,000	21,000	25,000	21,000	40,000	28,000
June	20,000	18,000	18,000	15,000	22,000	16,000
July	17,500	16,500	13,500	11,500	13,000	12,000
Aug.	15,500	13,500	13,500	12,000	12,800	11,000
Sept.	12,000	10,000	13,000	11,500	14,000	13,000
Oct.	15,000	12,000	17,000	12,000	13,500	13,500

Des Joachims

	1953		1955		1962	
	Monthly	Weekly	Monthly	Weekly	Monthly	Weekly
May	34,000	27,000	30,000	27,000	48,000	32,000
June	22,000	20,000	21,000	17,000	26,000	20,000
July	18,000	17,000	16,000	13,000	15,000	13,000
Aug.	16,000	13,000	13,000	13,000	13,000	13,000
Sept.	12,000	10,000	14,000	12,000	14,000	14,000
Oct.	16,000	14,000	19,000	13,000	15,000	14,000

Chats Falls

	1953		1955		1962	
	Monthly	Weekly	Monthly	Weekly	Monthly	Weekly
May	49,000	36,000	49,000	42,000	73,000	42,000
June	29,000	27,000	29,000	23,000	35,000	27,000
July	22,000	21,000	21,000	19,000	20,000	17,000
Aug.	19,000	17,000	16,000	15,000	16,000	15,000
Sept.	16,000	15,000	15,000	14,000	16,500	16,000
Oct.	18,000	16,000	23,000	15,000	18,000	17,000

* For record purposes, the discharge at Temiskaming is taken as the inflow to Otto Holden. During periods of low runoff the difference is minimal or insignificant because of regulation; however, during high runoff periods when both outlets of Lake Kipawa could be opened the discharge at Temiskaming could be as much as 10% less than the inflow to Holden.

TABLE 4.7 (continued)

Gatineau River

	1953		1955		1962	
	Monthly	Weekly	Monthly	Weekly	Monthly	Weekly
May	65,500	46,000	71,000	44,500	89,500	61,500
June	39,500	37,000	41,500	33,500	47,000	40,000
July	32,500	30,500	31,000	28,000	31,000	25,000
Aug.	29,000	25,500	34,000	23,500	27,000	26,500
Sept.	26,000	24,500	25,000	24,000	26,000	25,000
Oct.	28,500	26,000	30,500	21,000	26,000	25,000

Lievre River

	1953		1955		1962	
	Monthly	Weekly	Monthly	Weekly	Monthly	Weekly
May	74,500	53,000	82,000	51,000	97,500	69,000
June	45,000	42,000	46,500	38,500	53,000	46,000
July	38,000	35,500	36,000	33,000	37,000	31,000
Aug.	34,000	31,000	29,000	28,000	31,000	31,000
Sept.	29,500	25,000	30,000	29,000	30,000	29,000
Oct.	32,500	30,000	35,000	26,000	30,500	29,000

Grenville

	1953		1955		1962	
	Monthly	Weekly	Monthly	Weekly	Monthly	Weekly
May	86,000	63,000	85,000	62,500	107,000	73,500
June	51,500	47,500	51,000	46,500	57,000	49,500
July	42,500	40,500	39,500	36,000	38,500	33,000
Aug.	37,000	35,000	31,500	30,500	32,500	32,000
Sept.	33,000	30,500	31,500	29,500	33,000	31,500
Oct.	36,500	35,000	39,500	30,500	33,500	32,000

Carillon

	1953		1955		1962	
	Monthly	Weekly	Monthly	Weekly	Monthly	Weekly
May	90,000	63,500	103,500	63,000	112,000	82,000
June	52,500	48,000	53,000	47,000	60,500	52,000
July	44,000	40,500	40,000	36,000	42,000	35,000
Aug.	37,500	35,500	31,500	30,500	34,500	33,500
Sept.	33,000	31,000	31,500	30,000	34,000	32,500
Oct.	36,000	35,000	38,000	31,000	35,500	32,500

TABLE 4.3
COMPARISON OF NATURAL DESIGN FLOWS AND
NATURAL FLOWS FOR SELECTED CALENDAR YEARS (CFS)

Location	Design Minimum Monthly or Minimum 4-Week Low Flow (May-October)	Minimum Monthly or 4-Week Low Flow (May-October) for Year Indicated	
		Flow	Year
Grenville-Carillon	17,600	16,600	1953
		15,200	1955
		20,600	1962
Chats Falls	9,400	8,000	1953
		8,300	1955
		11,000	1962
Timiskaming Dam	5,400	4,100	1953
		5,800	1955
		5,200	1962

TABLE 4.9
DESIGN FLOWS

Location	Flow (cfs)
Otto Holden	10,000
Des Joachims	10,000
Chats Falls	14,000
Gatineau River	24,000
Lievre River	29,000
Grenville	29,500
Carillon	30,000

TABLE 4.10

OTTAWA RIVER - ZONES 1 AND 2
REACTION RATES AND LOADING VALUES EMPLOYED TO ESTABLISH LOADING GUIDELINES

Section Mile to Mile	Time of Travel (days) to		Stream- flow (cfs)	Water Temper- ature °C	DO mg/l	L _O (lbs/day)	K _r	K _d	K ₂	S
I 129.0 to 126.9	0.00	0.30	14,500	25	7.30	315,000	0.40	0.40	0.09	0
II 126.9 to 123.7	0.30	0.60	24,000	25	7.14	381,000	0.40	0.40	0.51	0
III 123.7 to 122.1	0.60	0.75	24,000	25	7.01	556,000	0.40	0.40	0.44	0
IV 122.1 to 113.3	0.75	1.55	24,000	25	6.85	563,000	0.40	0.40	0.44	0
V 113.3 to 106.9	1.55	2.15	29,000	25	6.67	510,000	0.40	0.40	0.165	0
VI 106.9 to 102.8	2.15	2.55	29,000	25	5.90	401,570	0.195	0.195	0.165	0
VII 102.8 to 93.7	2.55	3.40	29,000	25	5.87	406,000	0.195	0.195	0.165	0

TABLE 4.10 (continued)

OTTAWA RIVER - ZONES 1 AND 2
REACTION RATES AND LOADING VALUES EMPLOYED TO ESTABLISH LOADING GUIDELINES

Section Mile to Mile	Time of Travel (days) to		Stream- flow (cfs)	Water Temper- ature °C	DO mg/l	L _O (lbs/day)	K _r	K _d	K ₂	S
VIII 93.7 to 75.9	3.40	5.65	29,000	25	5.83	344,000	0.125	0.125	0.065	30,000
IX 75.9 to 68.0	5.65	6.55	29,000	25	5.27	259,650	0.075	0.075	0.065	0
X 68.0 to 63.4	6.55	7.05	30,000	25	5.34	472,000	0.465	0.465	0.35	0
XI 63.4 to 56.8	7.05	8.25	30,000	25	5.27	374,100	0.195	0.195	0.13	0
XII 56.8 to 47.1	8.25	9.25	30,000	25		296,000	0.125	0.125	0.21	0

TABLE 4.11

OTTAWA RIVER - ZONE 4
REACTION RATES AND LOADING VALUES EMPLOYED TO ESTABLISH LOADING GUIDELINES

Section Mile to Mile	Time of Travel (days) to		Stream- flow (cfs)	Water Temper- ature °C	DO mg/l	L _o (lbs/day)	K _r	K _d	K ₂	S
I 372.3 to 366.4	0.00	0.6	10,000	25	7.54	280,000	0.158	0.158	0.466	30,000
II 366.4 to 340.9	0.6	1.6	10,000	25	7.04	254,675	0.158	0.158	0.155	0
III 349.5 to 340.9	1.6	11.0	10,000	25	6.59	217,454	0.085	0.085	0.023	0
IV 340.9 to 314.9	11.0	16.0	10,000	25	4.97	97,800	0.036	0.036	0.023	0
V 314.9 to 305.1	16	20	10,000	25	5.06	81,700	0.036	0.036	0.047	0

CHAPTER 5

POPULATION PROJECTIONS

This chapter gives a detailed breakdown of the population projections for various areas of the Ottawa River Basin. In order to illustrate the present and expected trends, the population for 1961 and 1966 have been listed with the 1991 projected population. The source of the background data and the factors taken into consideration in the analysis has been discussed in Volume I of the Ottawa River Report (Chapter 2). Also, Appendix C of that volume is a summary of Table 5.1 listed below.

Presently, there is a tendency to regroup municipalities and urban centres into urban communities. Subsequently, it is difficult to project population figures for small municipalities of less than 500 and for the non-organized territories. Therefore, it should be noted that the total population figure of the tributary basins for 1991 are not necessarily the sum of the municipalities listed but rather a projection figure for that basin.

TABLE 5.1
POPULATION BY TRIBUTARY BASIN
OTTAWA RIVER BASIN

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
1. Rigaud	Hawkesbury East - Prescott	1,890	1,701	1,320
	Hawkesbury West - Prescott	179	190	280
	Kenyon - Glengarry	1,130	1,034	760
	Lochiel - Glengarry	3,527	3,221	3,000
	<i>Total (Rural)</i>	6,726	6,146	5,360
2. Ottawa River (Hawkesbury -Cumberland)	Hawkesbury - Prescott	8,661	9,188	14,000
	Rockland - Prescott	3,037	3,513	6,000
	Vankleek Hill - Prescott	1,735	1,662	5,000
	Alfred - Prescott	1,195	1,225	1,500
	L'Orignal - Prescott	1,189	1,238	1,600
	<i>Total (Urban)</i>	15,817	16,826	28,100
	Alfred - Prescott	1,350	1,240	840
	Caledonia - Prescott	210	195	135
	Clarence - Russell	1,650	1,420	1,400
	Hawkesbury East - Prescott	1,260	1,134	880
	Hawkesbury West - Prescott	1,430	1,519	2,240
	Longueuil - Prescott	933	903	800
	Plantagenet North - Prescott	480	328	225
	Cumberland - Russell	2,200	2,512	3,200
	<i>Total (Rural)</i>	9,513	9,251	9,820
	<i>TOTAL</i>	25,330	26,077	37,820
3. South Nation	Casselman - Russell	1,277	1,227	1,800
	Plantagenet - Prescott	-	836	1,200
	Maxville - Glengarry	804	771	900
	St. Isidore de Prescott	-	530	1,000
	Gloucester Twp. - Carleton	10,100	12,773	22,000
	Winchester - Dundas	1,429	1,450	2,000
	Chesterville - Dundas	1,248	1,258	1,600
	Finch - Stormont	386	384	550
	<i>Total (Urban)</i>	15,244	19,229	31,050

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
3. South Nation (cont'd)	Alfred - Prescott	580	531	360
	Caledonia - Prescott	1,190	1,106	765
	Cambridge - Russell	2,510	2,338	2,500
	Hawkesbury West - Prescott	179	190	280
	Clarence - Russell	3,100	2,637	2,600
	Plantagenet North - Prescott	2,350	1,599	1,275
	Plantagenet South - Prescott	2,393	1,840	1,300
	Russell - Russell	3,863	3,693	3,500
	Finch - Stormont	2,413	2,266	1,900
	Kenyon - Glengarry	1,690	1,551	1,140
	Matilda - Dundas	2,300	2,300	2,280
	Mountain - Dundas	2,543	2,455	2,000
	Osnabruck - Stormont	420	400	400
	Williamsburgh, Dundas	1,500	1,472	1,450
	Winchester - Dundas	2,869	2,821	2,900
	Augusta - Grenville	2,780	2,950	3,225
	Edwardsburgh - Grenville	3,100	3,250	3,400
	Gower South - Grenville	450	458	533
	Oxford - Grenville	580	597	725
	Elizabethtown - Leeds	492	538	540
	Cumberland - Russell	3,300	3,717	4,800
	Osgoode - Carleton	4,900	5,687	6,800
	Roxborough - Stormont	2,330	2,150	1,400
	<i>Total (Rural)</i>	47,832	46,596	46,073
	<i>TOTAL</i>	63,067	65,825	77,123
4. Ottawa City Area	Ottawa - Ottawa Carleton	268,206	290,741	470,000
	Vanier - Ottawa Carleton	24,555	24,269	30,000
	Rockcliffe Park - Ottawa Carleton	2,084	2,246	2,500
	Gloucester - Ottawa Carleton	4,600	5,805	10,000
	Nepean - Ottawa Carleton	3,950	8,784	12,000
	<i>Total (Urban)</i>	303,395	331,845	524,500
5. Ottawa River (Stittsville - Pembroke)	Stittsville - Ottawa Carleton	1,508	1,651	2,500
	Pembroke - Renfrew	16,791	16,262	22,000
	Beachburg - Renfrew	542	531	550
	Braeside - Renfrew	528	530	550
	<i>Total (Urban)</i>	19,369	18,974	25,600

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
5. Ottawa River (cont'd)	Fitzroy - Ottawa Carleton	1,405	1,109	1,100
	Goulbourn - Ottawa Carleton	215	283	500
	Huntley - Ottawa Carleton	1,150	1,197	1,360
	March - Ottawa Carleton	968	1,886	3,000
	Torbolton - Ottawa Carleton	757	809	900
	Horton - Renfrew	805	810	1,050
	Pembroke - Renfrew	765	836	1,600
	Ross - Renfrew	1,240	1,268	1,275
	Westmeath - Renfrew	1,580	1,438	1,200
	McNab - Renfrew	1,320	1,418	1,800
	<i>Total (Rural)</i>	10,205	11,054	13,785
	<i>TOTAL</i>	29,574	30,028	39,385
6. Rideau	Kemptville - Grenville	1,959	2,182	3,000
	Merrickville - Grenville	947	931	1,000
	Westport - Grenville	711	616	500
	Gloucester - Grenville	3,660	4,644	8,000
	Richmond - Ottawa Carleton	1,215	1,391	2,000
	Nepean - Ottawa Carleton	15,800	35,135	48,000
	Smith Falls - Lanark	9,603	9,876	11,500
	Perth - Lanark	5,360	5,559	6,200
	<i>Total (Urban)</i>	39,255	60,334	80,200
	Augusta - Grenville	930	950	1,075
	Bastard & South Burgess	800	750	730
	- Leeds			
	North Crosby - Leeds	663	616	500
	Elizabethtown - Leeds	1,970	2,152	2,160
	South Bumsley - Leeds	1,019	1,105	1,500
	Kitley - Leeds	1,624	1,731	2,000
	Gower South - Grenville	225	229	267
	Oxford - Grenville	1,760	1,800	2,175
	Wolford - Grenville	1,069	1,052	1,000
	Bedford - Frontenac	394	378	325
	Hinchinbrooke - Frontenac	272	288	300
	Olden - Frontenac	182	173	170
	Oso - Frontenac	114	112	100
	Goulbourn - Ottawa Carleton	1,930	2,550	4,500
	Gower North - Ottawa Carleton	2,694	2,873	5,000
	Marlborough - Ottawa Carleton	953	955	1,300
	Osgoode - Ottawa Carleton	870	1,003	1,200
	Bathurst - Lanark	942	908	950
	Beckwith - Lanark	760	858	943
	North Burgess - Lanark	462	495	450
	Drummond - Lanark	570	600	620
	North Elmsley - Lanark	1,048	1,225	1,600
	Montague - Lanark	4,654	4,687	5,500
	South Sherbrooke - Lanark	290	241	200
	<i>Total (Rural)</i>	26,195	27,728	34,565
	<i>TOTAL</i>	65,450	88,062	114,765

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
7. Madawaska	Bancroft - Hastings	2,615	2,152	2,800
	Arnprior - Renfrew	5,474	5,693	8,500
	Barry's Bay - Renfrew	1,439	1,388	1,500
	<i>Total (Urban)</i>	9,528	9,233	12,800
	Bangor, Wicklow, McClure - Hastings	963	745	600
	Carlow - Hastings	420	348	270
	Dungannon - Hastings	1,113	901	800
	Faraday - Hastings	785	509	600
	Herschell - Hastings	-	569	600
	Mayo - Hastings	425	382	400
	Monteagle - Hastings	1,200	984	700
	Limerick - Hastings	112	73	70
	Tudor, Cashel - Hastings	95	84	70
	Adamston - Renfrew	198	194	180
	Bagot & Blithfield - Renfrew	810	1,002	1,120
	Brougham - Renfrew	288	282	200
	Brudnell & Lyndoch - Renfrew	850	771	638
	Grattan - Renfrew	530	527	520
	Griffith & Matawachan - Renfrew	411	362	350
	McNab - Renfrew	1,970	2,128	2,700
	Radcliffe - Renfrew	728	670	700
	Raglan - Renfrew	734	642	600
	Sebastopol - Renfrew	623	562	540
	Sherwood, Jones, Burns - Renfrew	585	644	652
	Darling - Lanark	130	107	100
	Pakenham - Lanark	284	284	250
	Penbigh, Abinger, Ashby - Renfrew	456	425	358
	Airy - Nipissing	-	905	900
	Murchison - Nipissing	-	387	400
	Dickens - Nipissing	-	17	20
	Canisbay	-	40	40
	Palmerston, North and South Canonto - Frontenac	128	108	83
	Clarendon & Miller - Frontenac	189	168	150
	Effingham, Anglesea, Kaladar - Lennox and Addington	117	138	135
	Cardiff & Harcourt - Haliburton	190	142	120
	<i>Total (Rural)</i>	14,334	15,100	14,860
	<i>TOTAL</i>	23,862	24,333	27,666

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
8. Indian & Muskrat	Cobden - Renfrew	942	902	1,000
	<i>Total (Urban)</i>	942	902	1,000
	Alice & Fraser - Renfrew	1,880	1,866	1,890
	Bromley & Renfrew	1,010	923	770
	Pembroke & Renfrew	192	209	400
	Ross - Renfrew	415	423	425
	Stafford - Renfrew	3,131	3,475	4,700
	Westmeath - Renfrew	396	360	300
	Wilberforce - Renfrew	1,197	1,125	1,148
	Master - Nipissing	-	5	5
	<i>Total (Rural)</i>	8,221	8,386	9,638
	<i>TOTAL</i>	9,163	9,288	10,638
9. Bonnechere	Renfrew - Renfrew	8,935	9,502	15,000
	Eganville & Indian Reserve - Renfrew	1,790	1,705	2,250
	Killaloe Stn. - Renfrew	932	825	950
	<i>Total (Urban)</i>	11,657	12,032	18,200
	Adamston - Renfrew	1,125	1,094	1,020
	Algona North - Renfrew	551	551	500
	Algona South - Renfrew	373	321	300
	Alice & Fraser - Renfrew	208	207	210
	Bagot & Blithfield - Renfrew	101	125	140
	Bromley - Renfrew	435	395	330
	Brudnell & Lyndoch - Renfrew	150	136	112
	Gratten - Renfrew	795	791	780
	Hagarty, Richards - Renfrew	1,638	1,436	1,450
	Horton - Renfrew	805	810	1,050
	Sebastopol - Renfrew	418	374	360
	Sherwood, Jones, Burns - Renfrew	716	786	798
	Wilberforce - Renfrew	211	198	202
	Master - Nipissing	-	8	8
	<i>Total (Rural)</i>	7,526	7,232	7,260
	<i>TOTAL</i>	19,183	19,264	25,460
10. Ottawa River (Deep River)	Deep River - Renfrew	5,377	5,573	7,500
	Chalk River - Renfrew	1,135	1,086	1,100
	<i>Total (Urban)</i>	6,512	6,659	8,600
	Head, Clara, Maria - Renfrew	549	554	500
	Petawawa	3,740	3,202	3,200
	Rolph, Buchanan, Wylie, McKay - Renfrew	1,350	1,326	1,300
	Papineau - Nipissing	215	207	210
	Cameron - Nipissing	111	96	150
	<i>Total (Rural)</i>	5,965	5,385	5,360
	<i>TOTAL</i>	12,477	12,044	13,960

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
11. Mississippi	Barrie - Frontenac	409	433	430
	Almonte - Lanark	3,267	3,556	4,300
	Carleton Place - Lanark	4,796	4,819	5,200
	Lanark - Lanark	918	957	1,150
	<i>Total (Urban)</i>	9,390	9,765	11,080
	Clarendon & Miller	373	337	300
	- Frontenac			
	Kennebec - Frontenac	79	69	50
	Olden - Frontenac	547	518	440
	Oso - Frontenac	1,030	1,009	900
	Palmerston North & South	257	215	167
	Canonto - Frontenac			
	Fitzroy - Ottawa Carleton	1,155	1,109	1,100
	Huntley - Ottawa Carleton	540	563	640
	Bagot & Blithfield - Renfrew	101	125	140
	Bathurst - Lanark	943	905	950
	Beckwith - Lanark	410	462	507
	Dalhousie & North Sherbrooke	869	797	700
	- Lanark			
	Darling - Lanark	195	160	150
	Drummond - Lanark	855	900	930
	Lanark - Lanark	873	794	650
	Lavant - Lanark	261	215	200
	Pakenham - Lanark	850	852	750
	Ramsay - Lanark	1,672	1,715	1,850
	South Sherbrooke - Lanark	290	242	200
	Denbigh, Abinger, Ashey	246	225	192
	- Lennox & Addington			
	Effingham, Anglesea, Kaladar	193	168	165
	- Lennox & Addington			
	<i>Total (Rural)</i>	11,739	11,380	10,981
	<i>TOTAL</i>	21,129	21,145	22,061
12. Petawawa	Petawawa - Renfrew	4,509	5,574	6,000
	<i>Total (Urban)</i>	4,509	5,574	6,000
	Petawawa - Renfrew	5,600	4,803	4,800
	Rolph, Buchanan, Wylie	728	714	700
	- McKay - Renfrew			
	Cameron - Nipissing	74	64	100
	Master - Nipissing	-	13	13
	White - Nipissing	44	43	40
	Lister - Nipissing	18	16	15
	Deacon - Nipissing	82	25	25
	Boyd - Nipissing	10	2	5
	<i>Total (Rural)</i>	6,556	5,680	5,698
	<i>TOTAL</i>	11,065	11,254	11,698

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
13. Jocko	French - Nipissing	20	31	35
	Stewart - Nipissing	6	4	5
	Jocko - Nipissing	69	66	60
	<i>Total (Rural)</i>	95	101	100
14. Mattawa	Bonfield - Nipissing	714	577	650
	Mattawa - Nipissing	3,314	3,143	4,000
	<i>Total (Urban)</i>	4,028	3,720	4,650
	Bonfield - Nipissing	997	885	1,000
	Calvin - Nipissing	513	518	500
	Chisholm - Nipissing	187	165	220
	Ferris East - Nipissing	904	1,023	1,250
	Papineau - Nipissing	503	483	490
	Pentland - Nipissing	359	321	300
	Boulter - Nipissing	36	25	20
	Lauder - Nipissing	14	8	10
	Phelps - Nipissing	622	676	700
	French - Nipissing	12	19	21
	Ferris West - Nipissing	150	220	250
	Widdifield - Nipissing	105	300	350
	<i>Total (Rural)</i>	4,402	4,643	5,111
	<i>TOTAL</i>	8,430	8,363	9,761
15. Blanche	Charlton - Timiskaming	157	147	100
	Englehart - Timiskaming	1,786	1,790	2,100
	Thornloe - Timiskaming	211	157	170
	<i>Total (Urban)</i>	2,154	2,094	2,370
	Armstrong - Timiskaming	1,203	1,384	1,700
	Brethour - Timiskaming	296	258	300
	Casey - Timiskaming	679	604	650
	Chamberlain - Timiskaming	429	377	300
	Dack - Timiskaming	507	458	500
	Evanturel - Timiskaming	714	686	750
	Hilliard - Timiskaming	398	385	400
	Larder Lake - Timiskaming	2,187	1,582	2,000
	McBarry - Timiskaming	2,998	2,034	2,500
	Teck - Timiskaming	17,422	15,784	10,700
	Gauthier - Timiskaming	297	248	200
	Cane - Timiskaming	122	114	120
	Henwood - Timiskaming	128	104	100
	Beauchamp - Timiskaming	142	138	120
	Bryce - Timiskaming	23	17	20
	Traux - Timiskaming	9	15	20

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
15. Blanche (cont'd)	Robillard - Timiskaming	259	231	200
	Ingram - Timiskaming	228	218	200
	Pense - Timiskaming	27	15	15
	Marter - Timiskaming	213	146	100
	Savard - Timiskaming	177	126	100
	Sharpe - Timiskaming	51	46	40
	Gross - Timiskaming	11	21	25
	Marquis - Timiskaming	167	164	160
	Picaud - Timiskaming	152	141	140
	Catherine - Timiskaming	15	11	10
	Boston - Timiskaming	47	43	40
	Otto - Timiskaming	389	367	350
	Eby - Timiskaming	68	60	60
	Grenfell - Timiskaming	84	93	100
	Lebel - Timiskaming	602	524	500
	Katrine - Timiskaming	38	6	10
	Morrisette - Timiskaming	0	20	20
	Maisonville - Timiskaming	97	79	70
	Clifford - Timiskaming	7	5	5
	<i>Total (Rural)</i>	30,176	26,504	22,525
	<i>TOTAL</i>	32,330	28,598	24,895
16. Montreal	Cobalt - Timiskaming	2,209	2,211	2,200
	Lachford - Timiskaming	479	467	450
	<i>Total (Urban)</i>	2,688	2,678	2,650
	Coleman - Timiskaming	712	741	750
	James - Timiskaming	701	620	700
	Lorrain - Timiskaming	14	24	25
	Gillies Limit - Timiskaming	16	11	12
	Barr - Timiskaming	11	16	20
	Firstbrook - Timiskaming	23	30	30
	Tyrell - Timiskaming	19	2	10
	Milner - Timiskaming	9	5	10
	Nicor - Timiskaming	417	340	300
	Lawson - Timiskaming	15	8	10
	Barker - Timiskaming	33	23	20
	Haultain - Timiskaming	124	24	20
	Willison - Timiskaming	0	14	20
	Powell - Timiskaming	0	31	40
	Cairo - Timiskaming	0	712	700
	<i>Total (Rural)</i>	2,094	2,601	2,667
	<i>TOTAL</i>	4,782	5,279	5,317

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
17. Ottawa River (Haileybury)	Haileybury - Timiskaming	2,638	3,117	4,000
	New Liskeard - Timiskaming	4,896	5,259	7,000
	<i>Total (Urban)</i>	7,534	8,376	11,000
	Mattawan - Nipissing	105	82	100
	French - Nipissing	8	13	14
	Poitras - Nipissing	630	799	850
	Wyse - Nipissing	160	98	100
	Bucke - Timiskaming	1,774	1,691	2,000
	Dymond - Timiskaming	934	953	1,000
	Harley - Timiskaming	534	528	500
	Harris - Timiskaming	337	351	350
	Hudson - Timiskaming	379	402	450
	Kerns - Timiskaming	516	469	400
	Lorrain South - Timiskaming	29	28	26
	Lorrain - Timiskaming	40	74	75
	Firstbrook - Timiskaming	23	30	30
	Henwood - Timiskaming	128	105	100
	<i>Total (Rural)</i>	5,597	5,623	5,995
	<i>TOTAL</i>	13,131	13,999	16,995
18. Matabit-chuan	Askin - Nipissing	19	15	15
	Strathcona - Nipissing	43	51	60
	Cassels - Nipissing	66	58	50
	Best - Nipissing	28	4	10
	Strathy - Nipissing	620	670	700
	Lorrain South - Timiskaming	53	48	44
	Gillies Limit - Timiskaming	10	8	8
	<i>Total (Rural)</i>	839	854	887
19. Blanche River	Non-organized territory - Temiscamingue	236	203	-
20. Lac Barriere	Non-organized territory - Temiscamingue	3,338	3,225	-
21. Kinoyevis River	Amos, est - Abitibi	907	1,036	1,400
	Amos, ouest - Abitibi	896	1,563	2,100
	Cadillac - Abitibi	1,077	1,370	1,800
	Rouyn - Temiscamingue	18,716	18,851	27,000
	Noranda - Temiscamingue	11,477	11,521	17,000
	Evain - Temiscamingue	761	696	1,000
	Evain - Temiscamingue	547	541	800
	<i>Total (Urban)</i>			

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
21. Kinoyevis River (cont'd)	Trecession - Abitibi	1,131	935	900
	Saint-Mathieu - Abitibi	478	441	-
	Non-organized territory	8,308	8,143	-
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	44,298	45,097	68,000
22. Ottawa River (Temiscamingue)	St-Bruno-de-Guigues	1,476	1,519	2,000
	- Temiscamingue			
	Notre-Dame-du-Nord	1,154	1,182	1,600
	- Temiscamingue			
	Notre-Dame-de-Lourdes-de Lorrainville	707	699	1,000
	- Temiscamingue			
	Duhamel-ouest	547	541	800
	- Temiscamingue			
	Ville-Marie - Temiscamingue	1,710	1,952	2,800
	St-Placide-de-Bearn	1,073	1,051	1,500
	- Temiscamingue			
	Lorrainville - Temiscamingue	945	887	1,200
	Temiscaming - Temiscamingue	2,517	2,799	4,000
	<i>Total (Urban)</i>			
	Nedelec - Temiscamingue	1,019	957	1,000
	Guerin - Temiscamingue	596	581	800
	St-Eugene-de-Guigues	878	890	1,200
	- Temiscamingue			
	Angliers - Temiscamingue	488	511	800
	Moffet - Temiscamingue	741	697	900
	Fugereville - Temiscamingue	812	843	1,500
	Latulipe et Gaboury	844	776	1,000
	- Temiscamingue			
	Devlin - Temiscamingue	728	528	500
	Granet - Temiscamingue	85	105	-
	Jourdan - Temiscamingue	52	14	-
	Landanet - Temiscamingue	219	225	-
	Laverlochere - Temiscamingue	5	2	-
	Mazerac - Temiscamingue	-	42	-
	Villars - Temiscamingue	13	-	-
	Chabert - Temiscamingue	6	-	-
	Bousquet - Abitibi	5	22	-
	Non-organized territory	1,992	2,156	-
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	19,496	19,947	28,000

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
23. Cama-chigama River	Non-organized territory - Abitibi	75	-	-
24. Capita-chouane River	Non-organized territory	76	104	-
25. Chocho-couane River	Non-organized territory - Abitibi - Pontiac	-	-	-
26. Kipawa River	Saint-Edouard-de-Fabre	1,066	962	1,200
	- Temiscamingue			
	Belleterre - Temiscamingue	638	825	1,000
	<i>Total (Urban)</i>			
	Non-organized territory	110	142	-
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	1,814	1,929	2,200
27. Beauchene River	Non-organized territory - Temiscamingue	41	-	-
28. Ottawa (Temiscamingue part sud 11)	Non-organized territory	44	4	-
29. Maganasipi River	Non-organized territory - Temiscamingue	-	-	-
30. Dumoine River	Non-organized territory - Temiscamingue (part) - Pontiac (part)	-	38	-
31. Ottawa (Pontiac 1)	Mansfield et Pontract	1,489	1,698	2,600
	- Pontiac			
	Rapides-des-Joachims	347	293	-
	- Pontiac			
	Non-organized territory	-	-	-
	- Pontiac			
	<i>Total (Rural)</i>	1,736	1,991	2,600

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
32. Schyan River	Sheen, Esher, Aberdeen et Malakoff (part)	84	68	-
	- Pontiac			
	Non-organized territory	-	7	-
	- Pontiac			
	<i>Total (Rural)</i>	84	74	-
33. Ottawa River Pontiac 2)	Isles-aux-Allumettes	580	592	1,000
	- Pontiac			
	Chapeau - Pontiac	540	592	1,000
	<i>Total (Urban)</i>			
	Sheen, Esher, Aberdeen et Malakoff (part)	169	137	-
	- Pontiac			
	Chichester - Pontiac	623	581	500
	Waltham et Bryson (part)	270	226	-
	- Pontiac			
	Isles-aux-Allumettes (part est) - Pontiac	414	406	600
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	2,596	2,549	4,000
34. Noire River	Waltham et Bryson (part)	271	227	-
	- Pontiac			
35. Coulonge River	Fort Coulonge - Pontiac	1,823	1,846	2,600
	<i>Total (Urban)</i>	1,823	1,846	2,600
	Non-organized territory	15	181	-
	- Pontiac			
	<i>Total (Rural)</i>	15	181	-
	<i>TOTAL</i>	1,838	2,027	2,600
36. Ottawa River (Pontiac 3)	Grand Calumet - Pontiac	1,305	1,206	1,200
	Campbell's Bay - Pontiac	1,024	1,084	1,200
	Bryson - Pontiac	537	626	1,000
	Clarendon - Pontiac	1,631	1,536	1,500
	Shawville - Pontiac	1,534	1,652	2,300
	<i>Total (Urban)</i>			
	Litchfield - Pontiac	798	728	700
	Portage-de-Fort	424	433	-
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	7,254	7,265	14,000

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
37. Quyon River	Bristol - Pontiac	1,113	1,042	1,400
	Aldfield - Pontiac	621	569	1,000
	<i>Total (Urban)</i>			
	Thorne - Pontiac	413	345	-
	<i>Total (Rural)</i>	413	345	-
	<i>TOTAL</i>	2,147	1,956	3,000
38. Ottawa River (Gatineau)	Onslow (south part) - Pontiac	649	628	1,600
	Quyon - Pontiac	816	843	1,000
	Eardley - Gatineau	1,067	1,033	1,400
	Hull (west part) - Gatineau	1,411	1,540	2,100
	Lucerne - Gatineau	5,762	8,282	12,400
	Aylmer - Gatineau	6,286	7,231	10,800
	Deschenes - Gatineau	2,090	1,791	2,900
	<i>Total (Urban)</i>	18,081	21,348	45,100
39. Gatineau River	Dorion - Pontiac	442	373	800
	Touraine - Gatineau	2,079	5,550	8,000
	Hull (west part) - Gatineau	1,411	1,541	2,100
	Sainte-Cecile-de-Masham - Gatineau	1,830	1,958	2,600
	Wakefield - Gatineau	953	922	1,300
	Wakefield (east part) - Gatineau	471	587	1,000
	Low Gatineau	1,155	1,048	1,300
	Aylwin - Gatineau	706	630	1,000
	Northfield - Gatineau	555	543	1,000
	Wright - Gatineau	1,585	1,094	1,000
	Gracefield - Gatineau	670	1,054	1,300
	Bouchette - Gatineau	739	682	1,000
	Blue Sea - Gatineau	537	506	1,000
	Messine - Gatineau	1,090	1,030	1,200
	Deleage - Gatineau	1,093	1,229	1,500
	Maniwaki - Gatineau	6,349	6,404	10,000
	Montcerf - Gatineau	771	821	1,000
	<i>Total (Urban)</i>			

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
39. Gatineau River (cont'd)	Onslow - Pontiac	257	274	-
	Alleyne et Cawood - Pontiac	219	207	-
	Wakefield - Gatineau	381	332	-
	Masham North - Gatineau	309	280	-
	Denholm - Gatineau	266	228	-
	Hincks - Gatineau	532	442	-
	Cameron - Gatineau	319	284	-
	Ste-Therese-de-la-Gatineau - Gatineau	474	544	700
	Egan South - Gatineau	401	435	-
	Aumond - Gatineau	704	670	700
	Bois-Franc - Gatineau	409	321	-
	Sicotte - Gatineau	900	872	1,000
	Lytton - Gatineau	373	386	1,000
	Non-organized territory - Gatineau	282	47	-
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	28,262	31,294	55,000
40. Ottawa River (Hull)	Gatineau - Hull	13,022		
	Hull - Hull	56,929	60,176	108,000
	Perkins - Hull	947	1,181	1,500
	Pointe-Gatineau - Hull	8,854	11,053	20,000
	Templeton - Hull	2,965	3,267	6,000
	Templeton East - Hull	928	1,193	2,000
	Templeton West - Hull	943	611	1,000
	Angers - Papineau	575	742	1,200
	Masson - Papineau	1,933	2,249	3,000
	<i>Total (Urban)</i>			
	Templeton East (east part) - Hull	215	207	-
	Portland West - Papineau	480	431	-
	Buckingham (west part) - Papineau	275	270	-
	L'Ange-Gardien - Papineau	514	475	-
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	88,580	99,582	195,000

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
41. Lievre River	Buckingham (west part)	4,195	4,110	5,500
	- Papineau			
	Notre-Dame-du-Laus	1,390	1,312	1,300
	- Labelle			
	St-Aime-du-Lac-des-Iles	625	636	1,000
	- Labelle			
	Kiamika - Labelle	737	623	1,000
	Lac-des-Ecorces - Labelle	699	598	1,000
	Val-Barrette - Labelle	557	549	1,000
	Lac-des-Ecorces - Labelle	653	616	1,000
	Brunet - Labelle	1,273	1,520	2,100
	Robertson et Pope - Labelle	1,735	1,757	2,000
	Mont-Laurier - Labelle	5,859	6,140	9,000
	Ferme-Neuve - Labelle	1,971	1,944	2,600
	Ferme-Neuve - Labelle	1,279	1,055	1,000
	Mont-Saint-Michel - Labelle	970	841	1,000
	Decarie - Labelle	650	543	1,000
	<i>Total (Urban)</i>			
	Val-des-Bois - Papineau	295	284	-
	Bowman - Papineau	354	322	-
	Notre-Dame-de Pontmain	516	471	-
	- Labelle			
	Lac-du-Cerf - Labelle	393	385	-
	Saguay - Labelle	249	214	-
	Turgeon (part) - Labelle	330	349	-
	Chute-Saint-Philippe	390	368	-
	- Labelle			
	Lac-Saint-Paul - Labelle	384	398	-
	Sainte-Anne-du-Lac - Labelle	423	400	-
	Non-organized territory	14	-	-
	- Labelle			
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	25,941	25,328	33,000
42. Blanche	Buckingham (part)	3,710	3,613	5,000
	- Papineau			
	Thurso - Papineau	3,310	3,332	4,000
	<i>Total (Urban)</i>			

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
42. Blanche (cont'd)	Val-des-Bois (part)	296	284	-
	- Papineau			
	Mulgrave et Derry (part)	133	125	-
	- Papineau			
	Mayo - Papineau	184	183	-
	Buckingham (part) - Papineau	348	362	-
	Lochaber (part west)	424	432	-
	- Papineau			
	Buckingham (part west)	138	135	-
	- Papineau			
43. Petite Nation River	Buckingham (part southeast)	200	192	-
	- Papineau			
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	8,743	8,658	14,000
	Saint-Andre-Avellin	1,066	1,002	1,000
	- Papineau			
	Saint-Andre-Avellin	1,159	1,122	1,200
	- Papineau			
	<i>Total (Urban)</i>			
	Duhamel - Papineau	382	344	-
	Lac-des-Places - Papineau	264	190	-
	Suffolk & Addington	873	381	-
	- Papineau			
	Vindy - Papineau	218	147	-
	Namur - Papineau	-	407	-
	Cheneville - Papineau	746	746	800
	Lac Simon - Papineau	392	294	-
	Montpellier - Papineau	561	551	500
	Mulgrave and Derry (part)	133	125	-
	- Papineau			
	Ripon - Papineau	576	569	500
	Ripon - Papineau	646	605	600
	Lochaber (part north)	429	368	300
	- Papineau			
	Lochaber - Papineau	641	580	600
	Notre-Dame-de-la-Paix	729	655	600
	- Papineau			
	Loranger - Labelle	406	332	-
	Non-organized territory	73	67	-
	- Papineau			
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	9,294	8,585	15,000

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
44. Ottawa River (Papineau)	Montebello - Papineau	1,486	1,350	1,400
	Papineauville - Papineau	1,300	1,410	1,600
	Plaisance - Papineau	816	750	1,000
	Grenville (part) - Papineau	665	750	1,000
	<i>Total (Urban)</i>			
	Notre-Dame-du-Bon-Secours (part north) - Papineau	295	269	-
	Fassett - Papineau	578	545	-
	Sainte-Angelique - Papineau	577	605	600
	<i>Total (Rural)</i>			
	TOTAL	5,717	5,863	10,000
45. Rouge River	Grenville (part) - Argenteuil	665	751	1,000
	L'Annonciation - Labelle	1,042	2,040	2,500
	Saint-Adolphe-d'Howard - Argenteuil	1,298	1,265	1,200
	Marchand - Labelle	1,026	1,265	1,200
	La Macaza - Labelle	604	1,144	2,000
	La Minerva - Labelle	608	762	1,000
	Labelle - Labelle	1,224	1,307	2,000
	Sainte-Jovite - Terrebonne	528	671	2,000
	Sainte-Jovite - Terrebonne	2,692	3,083	7,000
	Mont-Tremblant - Terrebonne	757	818	2,000
	<i>Total (Urban)</i>			
	Harrington - Argenteuil	688	650	600
	Arundel - Argenteuil	456	414	400
	Huberdeau - Argenteuil	1,118	774	700
	Barkmere - Argenteuil	56	50	-
	Montcalm - Argenteuil	251	234	-
	Lac-des-Seize-Iles - Argenteuil	252	255	-
	Wenworth North - Argenteuil	336	334	-
	Wenworth (part) - Argenteuil	36	51	-
	Ponsonby - Papineau	256	226	-
	Amherst - Papineau	757	617	600
	Turgeon (part) - Labelle	331	349	-
	L'Ascension - Labelle	600	577	600
	Loranger - Labelle	406	332	-
	Bellerive-sur-le-lac - Labelle	119	118	-
	Joly - Labelle	422	438	-
	Lac Tremblant North - Labelle	2	1	-
	La Conception - Labelle	451	488	-
	Lac Superieur - Terrebonne	386	346	-

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
45. Rouge River (cont'd)	Saint-Faustin - Terrebonne	675	681	1,000
	Lac Carre - Terrebonne	687	671	800
	Brebeuf - Terrebonne	410	380	-
	Ivry-sur-le-Lac - Terrebonne	244	235	-
	Non-organized territory - Terrebonne	21	14	-
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	19,917	21,195	50,000
46. Ottawa River (Argenteuil)	Chatham - Argenteuil	2,822	2,818	6,000
	Brownsburg - Argenteuil	3,617	3,596	8,000
	Lachute - Argenteuil	7,560	10,215	22,000
	Calumet - Argenteuil	889	793	2,000
	Grenville - Argenteuil	1,847	1,836	4,000
	<i>Total (Urban)</i>			
	Wentworth (part) - Argenteuil	36	51	-
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	16,771	19,309	43,000
47. North River	Saint-Andre-d'Argenteuil - Argenteuil	830	791	2,000
	Saint-Jerusalem d'Argenteuil - Argenteuil	2,202	2,546	5,000
	Morin Heights - Argenteuil	1,262	1,143	2,000
	Sainte-Scholastique - Deux Montagnes	838	867	3,000
	Sainte-Scholastique - Deux Montagnes	1,472	1,520	10,000
	Saint-Canut - Deux Montagnes	1,114	1,248	2,000
	Saint-Hermas - Deux Montagnes	1,102	1,060	2,000
	Saint-Sophie - Terrebonne	1,502	2,195	4,000
	St-Antoine-des-Laurentides - Terrebonne	983	934	2,000
	St-Antoine-des-Laurentides - Terrebonne	3,005	4,401	10,000
	Bellefeuille (St-Jerome, paroisse) - Terrebonne	1,297	1,678	4,000
	Saint-Jerome - Terrebonne	24,546	26,511	55,000
	Lafontaine - Terrebonne	1,556	2,346	4,600
	Saint-Hippolyte - Terrebonne	930	1,195	2,500
	Lesage - Terrebonne	699	952	2,000
	Shawbridge - Terrebonne	1,034	1,038	2,000
	Piedmont - Terrebonne	465	643	1,000
	Mont-Gabriel - Terrebonne	35	43	4,000

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
47. North River (cont'd)	St-Sauveur-des-Monts	1,702	1,908	4,000
	- Terrebonne			
	Mont-Rolland - Terrebonne	1,875	1,797	4,000
	Sainte-Marguerite-du-Lac- Masson - Terrebonne	1,222	1,246	2,000
	Sainte-Adele - Terrebonne	3,228	3,690	8,000
	Val David - Terrebonne	752	701	1,000
	Val Morin - Terrebonne	1,118	1,281	2,000
	Sainte-Agathe-des-Monts - Terrebonne	5,725	6,010	12,000
	Sainte-Agathe-Sud - Terrebonne	0	881	2,000
	<i>Total (Urban)</i>			
	Carillon - Argenteuil	427	236	-
	Gore - Argenteuil	150	176	-
	Mille-Isles - Argenteuil	227	260	-
	Saint Colombar - Deux Montagnes	301	445	-
	New Glasgow - Terrebonne	144	115	-
	Sainte-Anne-des-Lacs - Terrebonne	343	467	1,000
	Prevost - Terrebonne	191	213	-
	Saint-Sauveur - Terrebonne	365	693	-
	Esterel - Terrebonne	12	133	-
	Lantier - Terrebonne	418	453	-
	Sainte-Agathe - Terrebonne	1,414	673	500
	Sainte-Lucie (Doncaster) - Terrebonne	409	381	-
	<i>Total (Rural)</i>	64,795	70,524	155,000
	<i>TOTAL</i>	64,795	70,524	155,000

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
48. Ottawa River (Deux Montagnes)	Saint-Andre-East	1,183	1,201	3,000
	- Argenteuil			
	Saint-Eustache - Deux Montagnes	3,801	5,419	12,000
	Saint-Eustache - Deux Montagnes	5,463	7,319	15,000
	Deux Montagnes - Deux Montagnes	7,274	8,069	17,000
	Sainte-Marthe-sur-le-Lac - Deux Montagnes	1,411	1,999	4,000
	Saint-Joseph-sur-le-Lac - Deux Montagnes	1,532	1,663	3,500
	Pointe-Calumet - Deux Montagnes	514	1,157	2,500
	L'Annonciation (part north) - Deux Montagnes	936	914	2,500
	Oka - Deux Montagnes	1,375	1,369	3,000
	Saint-Augustin - Deux Montagnes	1,137	1,325	3,000
	Saint-Augustin - Deux Montagnes	444	478	1,500
	Saint-Benoit - Deux Montagnes	971	999	2,000
	Saint-Benoit - Deux Montagnes	571	550	1,000
	Saint-Placide - Deux Montagnes	618	662	1,000
	Sainte-Monique - Deux Montagnes	1,177	1,223	2,500
	<i>Total (Urban)</i>			
	Oka-sur-le-Lac - Deux Montagnes	-	1	-
	Saint-Placide - Deux Montagnes	336	303	-
	Pointe Fortune - Vaudreuil	473	349	-
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	29,216	33,000	75,000

TABLE 5.1 (cont'd)

BASIN	MUNICIPALITY - COUNTY	POPULATION		
		1961	1966	1991
49. Ottawa River (Vaudreuil)	Notre-Dame-de-L'Isle-Perrot - Vaudreuil	1,060	1,280	3,000
	Terrasse-Vaudreuil - Vaudreuil	1,344	1,555	3,500
	Ile-Perrot - Vaudreuil	3,106	3,578	7,500
	Pincourt - Vaudreuil	2,685	5,656	12,000
	Dorion - Vaudreuil	4,996	6,033	12,500
	Vaudreuil (anciennement St-Michel-de-Vaudreuil) - Vaudreuil	2,906	3,105	6,000
	Como-Est - Vaudreuil			
	Hudson - Vaudreuil	1,671	1,642	3,500
	Hudson Heights - Vaudreuil	1,540	1,543	3,000
	Saint-Lazare - Vaudreuil	1,022	920	2,000
	<i>Total (Urban)</i>			
	Pointe-du-Moulin - Vaudreuil	104	186	-
	Ile-Cadieux - Vaudreuil	18	22	-
	Vaudreuil-sur-le-Lac - Vaudreuil	200	201	-
	Sainte-Marthe - Vaudreuil	261	240	-
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	21,720	26,988	60,000
50. Raquette River	Rigaud - Vaudreuil	1,990	1,959	4,000
	Ste-Madeleine-de-Rigaud (part) - Rigaud	830	831	2,000
	<i>Total (Urban)</i>			
	Sainte-Marthe - Vaudreuil	409	401	-
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	3,229	3,191	7,000
51. Rigaud River	Ste-Madeleine-de-Rigaud (part) - Vaudreuil	830	832	2,000
	<i>Total (Urban)</i>			
	Tres Saint-Redempteur - Vaudreuil	332	335	-
	<i>Total (Rural)</i>			
	<i>TOTAL</i>	1,162	1,167	2,900